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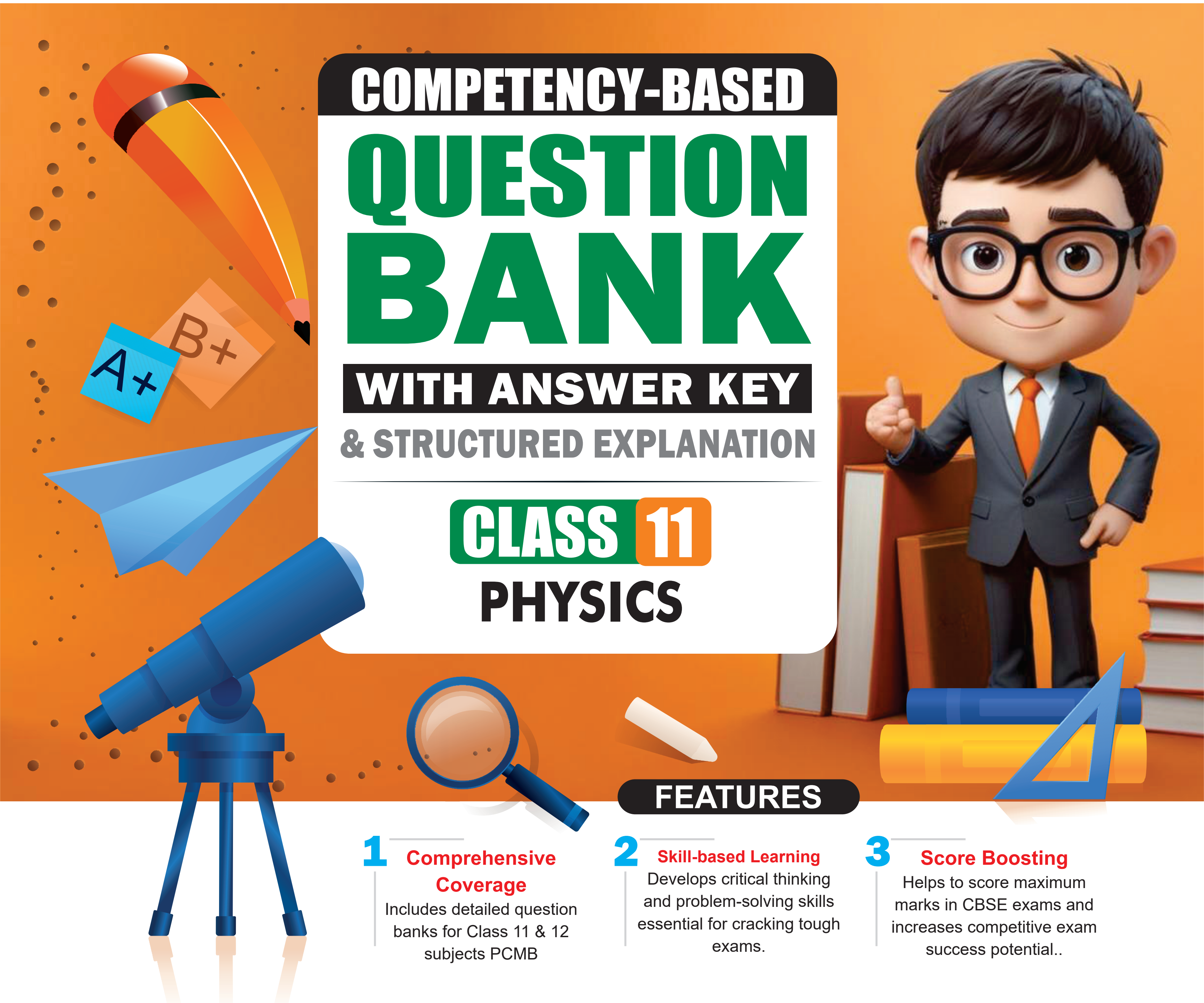
COMPETENCY-BASED

QUESTION BANK

WITH ANSWER KEY
& STRUCTURED EXPLANATION

CLASS 11

PHYSICS



FEATURES

1 Comprehensive Coverage
Includes detailed question banks for Class 11 & 12 subjects PCMB

2 Skill-based Learning
Develops critical thinking and problem-solving skills essential for cracking tough exams.

3 Score Boosting
Helps to score maximum marks in CBSE exams and increases competitive exam success potential..

4 Answer Key & Structured Explanations
Clear, well-structured explanations and step-by-step solutions to enhance understanding.

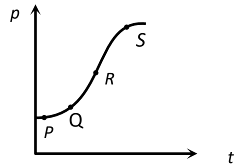
5 Exam Pattern Aligned
Questions modeled after the latest exam patterns to ensure students are well-prepared.

6 Competitive Exam Focus
Specially designed to help students excel in IIT, NEET, JEE, CUET, and other competitive exams.

7 NCERT Integration
Questions and answers are based on the NCERT syllabus, ensuring relevance for both CBSE board exams and entrance tests.

LAWS OF MOTION

1. The variation of momentum with time of one of the body in a two body collision is shown in fig. The instantaneous force is maximum corresponding to point



a) P b) Q c) R d) S

2. A 10 kg stone is suspended with a rope of breaking strength 30 kg wt. The minimum time in which the stone can be raised through a height 10 m starting from rest is (taking $g = 10\ N/kg$)

a) 0.5 $seconds$ b) 1.0 $seconds$ c) $\sqrt{\frac{2}{3}} seconds$ d) 2.0 $seconds$

3. A man is standing on a balance and his weight is measured. If he takes a step in the left side, then weight

a) Will decrease b) Will increase
c) Remains same d) First decreases then increases

4. A wagon weighing 1000 kg is moving with a velocity 50 km/h on smooth horizontal rails. A mass of 250 kg is dropped into it. The velocity with which it moves now is

a) 2.5 $km/hour$ b) 20 $km/hour$ c) 40 $km/hour$ d) 50 $km/hour$

5. Force required to move a mass of 1 kg at rest on a horizontal rough plane ($\mu = 0.1$ and $g = 9.8\ \text{ms}^{-2}$) is

a) 0.98 N b) 0.49 N c) 9.8 N d) 4.9 N

6. A block of base 10 cm × 10 cm and height 15 cm is kept on an inclined plane. The coefficient of friction between them is $\sqrt{3}$. The inclination θ of this inclined plane from the horizontal plane is gradually increased from 0°. Then

a) At $\theta = 30°$, the block will start sliding down the plane
b) The block will remain at rest on the plane up to certain θ and then it will topple
c) At $\theta = 60°$, the block will start sliding down the plane and continue to do so at higher angles
d) At $\theta = 60°$, the block will start sliding down the plane and on further increasing θ, it will topple at certain θ

7. A particle moves in the X-Yplane under the influence of a force such that its linear momentum is $\mathbf{p}(t) = A[\hat{\mathbf{i}}\cos(kt) - \hat{\mathbf{j}}\sin(kt)]$ where A and k are constant. The angle between the force and the momentum is

a) 0° b) 30° c) 45° d) 90°

8. Newton's first law of motion describes the following

a) Energy b) Work c) Inertia d) Moment of inertia

9. A 5000 kg rocket is set for vertical firing. The exhaust speed is 800 ms^{-1}. To give an initial upward acceleration of 20 ms^{-2} the amount of gas ejected per second to supply the needed thrust will be ($g = 10\ ms^{-2}$)

a) 127.5 kgs^{-1} b) 187.5 kgs^{-1} c) 185.5 kgs^{-1} d) 137.5 kgs^{-1}

10. In the above question, the acceleration of mass m is

a) $\frac{F}{m}$ b) $\frac{F-T}{m}$ c) $\frac{F+T}{m}$ d) $\frac{F}{M}$

11. A block moves down a smooth inclined plane of inclination θ. Its velocity on reaching the bottom is v. If it slides down a rough inclined plane of same inclination, its velocity on reaching the bottom is v/n, where n is a number greater than 1. The coefficient of friction is given by

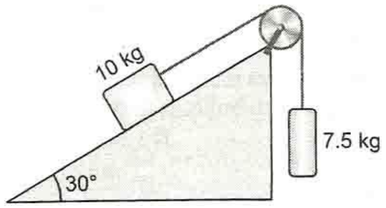
a) $\mu = \tan\theta\left(1-\frac{1}{n^2}\right)$ b) $\mu = \cot\theta\left(1-\frac{1}{n^2}\right)$
c) $\mu = \tan\theta\left(1-\frac{1}{n^2}\right)^{1/2}$ d) $\mu = \cot\theta\left(1-\frac{1}{n^2}\right)^{1/2}$

12. A shell is fired from a cannon with velocity $v ms^{-1}$ at an angle θ with the horizontal direction. At the

highest point in its path it explodes into two pieces of equal mass. One of the pieces retraces its path to the cannon and the speed in m/s of the piece immediately after the explosion is

a) $3v\cos\theta$ b) $2v\cos\theta$ c) $\frac{3v}{2}\cos\theta$ d) $\frac{\sqrt{3}v\cos\theta}{2}$

13. The acceleration of the system shown in figure is



a) $\frac{3.5}{17.5}g$ b) $\frac{7.5}{17.5}g$ c) $\frac{14.5}{17.5}g$ d) $\frac{g}{7}$

14. A man of weight mg is moving up in a rocket with acceleration 4g. the apparent weight of the man in the rocket is

a) Zero b) 4 mg c) 5 mg d) mg

15. A car is moving with uniform velocity on a rough horizontal road. Therefore, according to Newton's first law of motion

a) No force is being applied by its engine
b) A force is surely being applied by its engine
c) An acceleration is being produced in the car
d) The kinetic energy of the car is increasing

16. A motorcyclist of mass m is to negotiate a curve of radius r with a speed v. The minimum value of the coefficient of friction so that this negotiation may take place safely, is

a) v^2rg b) $\frac{v^2}{gr}$ c) $\frac{gr}{v^2}$ d) $\frac{g}{v^2r}$

17. A rope of mass0.1 kg is connected at the same height of two opposite walls. It is allowed to hang under its own weight. At the contact point between the rope and the wall, the rope makes an angle $\theta = 10°$ with respect to the horizontal. The tension in the rope at its midpoint between the wall is

a) 2.78 N b) 2.56 N c) 2.82 N d) 2.71 N

18. A lift of mass 1000 kg is moving with an acceleration of 1 m/s^2 in upward direction. Tension developed in the string, which is connected to the lift is ($g = 9.8\ m/s^2$)

a) 9,800 N b) 10,000 N c) 10, 800 N d) 11, 000 N

19. A 24 kg block resting on a floor has a rope tied to its top. The maximum tension, the rope can withstand without breaking is 310 N. The minimum time in which the block can be lifted a vertical distance of 4.6 m by pulling on the rope is

a) 1.2 s b) 1.3 s c) 1.7 s d) 2.3 s

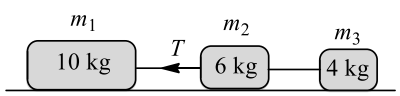
20. The mass of man when standing on lift is 60 kg. What is the weight when he is standing on lift which is moving upwards with acceleration 4.9 ms^{-2} ?

a) 882 kg b) 600 N c) 306 N d) Zero

21. While waiting in a car at a stoplight, and 80 kg man and his car are suddenly accelerated to a speed of 5 ms^{-1} as a result or rear end colllison. If the time of impact is 0.4 s, find the average force on the man

a) 100 N b) 200 N c) 500 N d) 1000 N

22. Three blocks of masses m_1, m_2 and m_3 are placed on a horizontal frictionless surface. A force of 40 N pulls the system then calculate the value of T, if $m_1 = 10$ kg, $m_2 = 6$ kg, $m_3 = 4$ kg



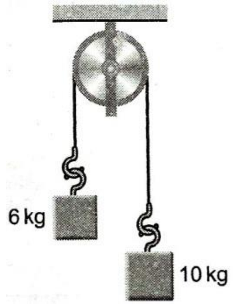
a) 40 N b) 20 N c) 10 N d) 5 N

23. A machine gun fires a bullet of mass 40 g with a velocity 1200ms^{-1}. The man holding it can exert a maximum force of 144 N on the gun. How many bullets can be fired per second at the most?

a) Only one b) Three

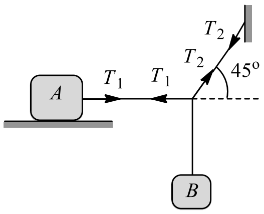
c) Can fire any number of bullets   d) 144×48

24. The tension in the string in the pulley system shown in the figure is



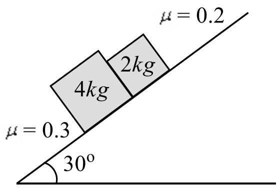
a) 75 N   b) 80 N   c) 7.5 N   d) 30 N

25. The block A in figure weight 100 N. The coefficient of static friction between the block and the table is 0.25. The weight of the block B is maximum for the system to be in equilibrium. The value of T_1 is



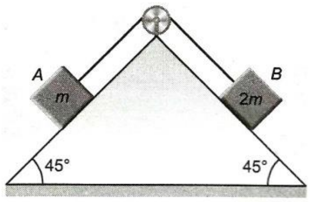
a) 0.25 N   b) 25 N   c) 100 N   d) 100.25 N

26. Two blocks, 4 kg and 2 kg are sliding down an incline plane as shown in figure. The acceleration of 2 kg block is



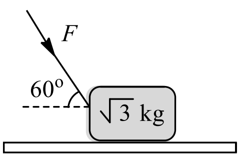
a) 1.66 m/s^2 b) 2.66 m/s^2 c) 3.66 m/s^2 d) 4.66 m/s^2

27. Block A of mass m and block B of mass $2m$ are placed on a fixed triangular wedge by means of a massless, inextensible string and a frictionless pulley as shown in figure. The wedge is inclined at 45° to the horizontal on both the sides. The coefficient of friction between the block A and the wedge is 2/3 and that between the block B and the wedge is 1/3 and both the blocks A and B are released from rest, the acceleration of A will be



a) -1 b) 1.2   c) 0.2   d) Zero

28. A block of mass $\sqrt{3}$ kg resting on a horizontal surface. A force F is applied on the block as shown in figure. If coefficient of friction between the block be $\frac{1}{2\sqrt{3}}$, what can be the maximum value of force F so that block does not start moving? (Take $g = 10\ ms^{-2}$)

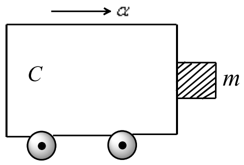


a) 20 N   b) 10 N   c) 12N   d) 15 N

29. A pendulum bob of mass 50 gm is suspended from the ceiling of an elevator. The tension in the string if the elevator goes up with uniform velocity is approximately

a) 0.30 N b) 0.40 N c) 0.42 N d) 0.50 N

30. A block of mass m is in contact with the cart C as shown in the figure



The coefficient of static friction between the block and the cart is μ. The acceleration α of the cart that will prevent the block from falling satisfies

a) $\alpha < \frac{g}{\mu}$ b) $\alpha > \frac{mg}{\mu}$ c) $\alpha > \frac{g}{\mu m}$ d) $\alpha \geq \frac{g}{\mu}$

31. An object at rest in space suddenly explodes into three parts of same mass. The momentum of the two parts are $2p\hat{\mathbf{i}}$ and $p\hat{\mathbf{j}}$. The momentum of the third part

a) Will have a magnitude $p\sqrt{3}$ b) Will have a magnitude $p\sqrt{5}$
c) Will have a magnitude p d) Will have a magnitude $2p$

32. A block of mass 1 kg slides down on a rough inclined plane of inclination 60° starting from its top. If the coefficient of kinetic friction is 0.5 and length of the plane is 1 m, then work done against friction is (Take $g = 9.8\ m/s^2$)

a) 9.82 J b) 4.94 J c) 2.45 J d) 1.96 J

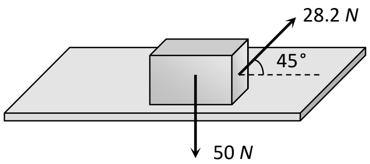
33. A 5000 kg rocket is set for vertical firing. The exhaust speed is800 ms^{-1}. To give an initial upward acceleration of 20 ms^{-2}, the amount of gas ejected per second to supply the needed thrust will be ($g =$ 10 ms^{-2})

a) 127.5 kgs^{-1} b) 187.5 kgs^{-1} c) 185.5 kgs^{-1} d) 137.5 kgs^{-1}

34. A rocket of mass 100 kg burns 0.1 kg of fuel per second. If velocity of exhaust gas is 1 kms^{-1}, then it lifts with an acceleration of

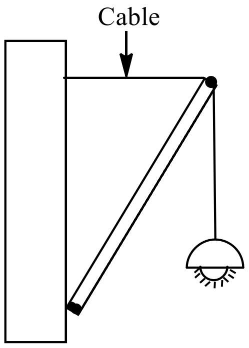
a) 1000 ms^{-2} b) 100 ms^{-2} c) 10 ms^{-2} d) 1 ms^{-2}

35. A body of weight 50 N placed on a horizontal surface is just moved by a force of 28.2 N. The frictional force and the normal reaction are

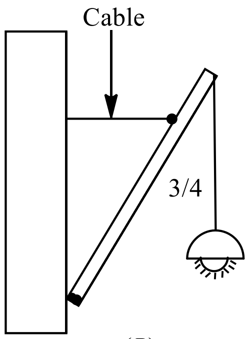


a) 10 N, 15 N b) 20 N, 30 N c) 2 N, 3 N d) 5 N, 6 N

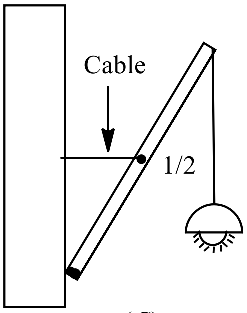
36. If a street light of mass M is suspended from the end of a uniform rod of length L in different possible patterns as shown in figure, then



(A)



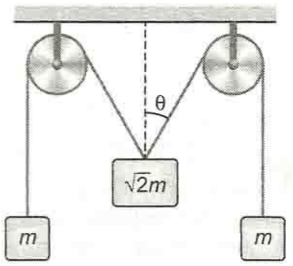
(*B*)



(*C*)

a) Pattern A is more sturdy
b) Pattern B is more sturdy
c) Pattern C is more sturdy
d) All will have same sturdiness

37. The pulley and strings shown in figure are smooth and of negligible mass. For the system to remain in equilibrium, the angle θ should be



a) 0°
b) 30°
c) 45°
d) 60°

38. A body of 10 kg is acted by a force of 129.4 N if $g = 9.8\ m/s^2$. The acceleration of the block is 10 m/s^2. What is the coefficient of kinetic friction

a) 0.03
b) 0.01
c) 0.30
d) 0.25

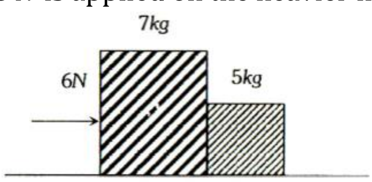
39. Two masses 8 kg and 12 kg are connected at the two ends of a string that goes over a frictionless pulley. Calculate the acceleration of the masses and the tension in the string. (Take $g = 10\ \mathrm{m/s^2}$)

a) $8\ \mathrm{m/s^2}$, 144 N
b) $4\ \mathrm{m/s^2}$, 112 N
c) $6\ \mathrm{m/s^2}$, 128 N
d) $2\ \mathrm{m/s^2}$, 96 N

40. A ball of mass 0.5 kg moving with a velocity of 2 m/sec strikes a wall normally and bounces back with the same speed. If the time of contact between the ball and the wall is one millisecond, the average force exerted by the wall on the ball is

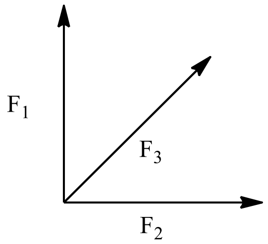
a) 2000 N
b) 1000 N
c) 5000 N
d) 125 N

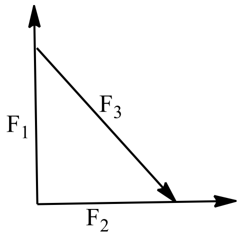
41. Two block of masses 7 kg and 5 kg are placed in contact with each other on a smooth surface. If a force of 6 N is applied on the heavier mass, the force on the lighter mass is

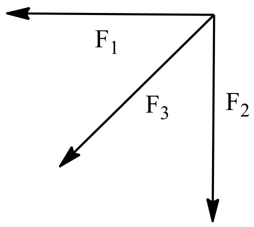


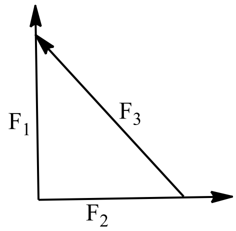
a) 3.5 N
b) 2.5 N
c) 7 N
d) 5 N

42. Which of the four arrangements in the figure correctly shows the vector addition of two forces F_1 and F_2 to yield the third force F_3?

a) 

b) 

c) 

d) 

43. A vehicle of 100 kg is moving with a velocity of 5 m/sec. To stop it in $\frac{1}{10}$ sec, the required force in opposite direction is

a) 5000 N b) 500 N c) 50 N d) 1000 N

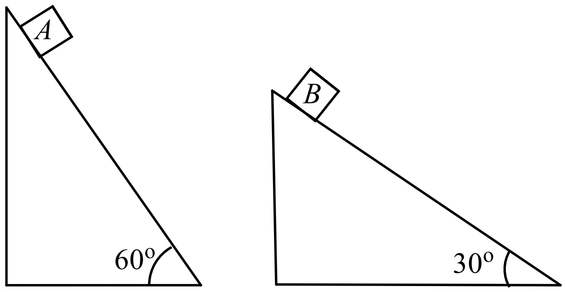
44. In which of the following cases forces may not be required to keep the

a) Particle going in a circle
b) Particle going along a straight line
c) The momentum of the particle constant
d) Acceleration of the particle constant

45. A bob of mass 0.450 kg hangs from the massless string of a long simple pendulum. A bullet of mass 0.50 kg is fired vertically from below into the bob. The bullet gets embedded into the bob and the combination rises vertically through a height of 1.8 m. If g = 10 ms^{-2}, then the velocity of the bullet is

a) 6 ms^{-1} b) 60ms^{-1} c) 600 ms^{-1} d) 6000ms^{-1}

46. Two fixed frictionless in inclined plane making an angle 30° and 60° with the vertical are shown in the figure. Two blocks A and B are placed on the two planes. What is the relative vertical acceleration of A with respect to B?



a) 4.9 ms^{-2}in horizontal direction
b) 9.8 ms^{-2} in vertical direction
c) Zero
d) 4.9 ms^{-2}in vertical direction

47. A given object takes n times more time to slide down a 45° rough inclined plane as it takes so slide down a perfectly smooth 45° incline. The coefficient of kinetic friction between the object and the incline is

a) $\frac{1}{1-n^2}$ b) $1-\frac{1}{n^2}$ c) $\sqrt{1-\frac{1}{n^2}}$ d) $\sqrt{\frac{1}{1-n^2}}$

48. A ball of mass 400 gm is dropped from a height of 5m. A boy on the ground hits the ball vertically upwards with a bat with an average force of 100 $newton$ so that it attains a vertical height of 20 m. The time for which the ball remains in contact with the bat is $[g = 10m/s^2]$

a) 0.12 s b) 0.08 s c) 0.04 s d) 12 s

49. An object is kept on a smooth inclined plane of 1 in l. The horizontal acceleration to be imparted to the inclined plane so that the object is stationary relative to the inclined is

a) $g\sqrt{l^2-1}$ b) $g(l^2-1)$ c) $\frac{g}{\sqrt{l^2-1}}$ d) $\frac{g}{l^2-1}$

50. A ball of mass m moves with speed v and it strikes normally with a wall and reflected back normally. If its time of contact with wall is t, then find force exerted by ball on the wall

a) $\frac{2mv}{t}$ b) $\frac{mv}{t}$ c) mvt d) $\frac{mv}{2t}$

51. A frictionless inclined plane of length l having inclination θ is placed inside a lift which is accelerating downward with an acceleration $a(< g)$. If a block is allowed to move, down the inclined plane, from rest, then the time taken by the block to slide from top of the inclined plane to the bottom of the inclined plane is

a) $\sqrt{\frac{2l}{g}}$ b) $\sqrt{\frac{2l}{g-a}}$ c) $\sqrt{\frac{2l}{g+a}}$ d) $\sqrt{\frac{2l}{(g-a)\sin\theta}}$

52. Impulse is
a) A scalar
b) Equal to change in the momentum of a body
c) Equal to rate of change of momentum of a body
d) A force

53. A body of mass 5 kg starts from the origin an initial velocity $\vec{u} = 30\hat{\imath} + 40\hat{\jmath} ms^{-1}$. If a constant force $\vec{F} = -(\hat{\imath} + 5\hat{\jmath})N$ acts on the body, the time in which the $y -$ component of the velocity becomes zero is
a) 5 *seconds* b) 20 *seconds* c) 40 *seconds* d) 80 *seconds*

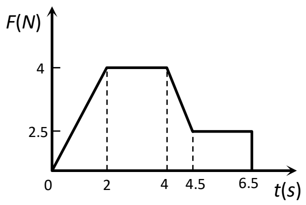
54. Consider the following statement: When jumping from some height, you should bend your knees as you come to rest, instead of keeping your legs stiff. Which of the following relations can be useful in explaining the statement
a) $\Delta\overrightarrow{P_1} = -\Delta\overrightarrow{P_2}$ b) $\Delta E = -\Delta(PE + KE) = 0$
c) $\vec{F}\Delta t = m\Delta\vec{v}$ d) $\Delta\vec{x} \propto \Delta\vec{F}$

55. The resultant of two forces $3P$ and $2P$ is R. If the first force is doubled then the resultant is also doubled. The angle between the two forces is
a) 60° b) 120° c) 70° d) 180°

56. A stick of 1 m is moving with velocity of $2.7 \times 10^8 ms^{-1}$. What is the apparent length of the stick ($c = 3 \times 10^8 ms^{-1}$)
a) 10 m b) 0.22 m c) 0.44 m d) 2.4 m

57. If two forces of 5 N each are acting along X and Y axes, then the magnitude and direction of resultant is
a) $5\sqrt{2}, \pi/3$ b) $5\sqrt{2}, \pi/4$ c) $-5\sqrt{2}, \pi/3$ d) $-5\sqrt{2}, \pi/4$

58. A body of 2 kg has an initial speed 5 ms^{-1}. A force acts on it for some time in the direction of motion. The force time graph is shown in figure. The final speed of the body



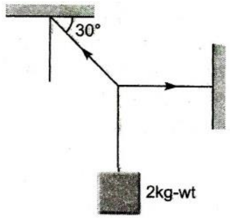
a) 9.25 ms^{-1} b) 5 ms^{-1} c) 14.25 ms^{-1} d) 4.25 ms^{-1}

59. There is a simple pendulum hanging from the ceiling of a lift. When the lift is stand still, the time period of the pendulum is T. If the resultant acceleration becomes $g/4$, then the new time period of the pendulum is
a) 0.8 T b) 0.25 T c) 2 T d) 4 T

60. The one –rupee coins are put on top of each other on a table. Each coin has a mass m. Which of the following statements is not true
a) The force on the 6th (counted from the bottom) due to all the coins on its top is equal to 4 mg (downwards)
b) The force on the 6th coin due to 7th coin is $4mg$ (downwards)
c) The reaction of the 6th coin on the 7thcoin is 4 mg (upwards)
d) The total force on the 10th coin is 9 mg (downwards)

61. Force of 4 N is applied on a body of mass 20 kg. The work done in 3rd second is
a) 2 J b) 4 J c) 16 J d) 1.2 J

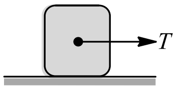
62. A body of weight 2 kg is suspended as shown in figure. The tension T_1 in the horizontal string (in kg-wt) is



a) $2/\sqrt{3}$ b) $\sqrt{3}/2$ c) $2\sqrt{3}$ d) 2

63. The ratio of the weight of a man in a stationary lift and when it is moving downward with uniform acceleration 'a' is 3: 2,. The value of 'a' is (g- Acceleration due to gravity of the earth)
a) $\frac{3}{2}g$ b) $\frac{g}{3}$ c) $\frac{2}{3}g$ d) g

64. In figure a block of weight 10 N is shown resting on a horizontal surface. The coefficient of static friction between the block and surface is $\mu_s = 0.4$. A force of 3.5 N will keep the block in uniform motion, once it has been in motion. A horizontal force of 3 N is applied to the block. The block will there



a) Move over the surface with a constant velocity
b) Moves having accelerated motion over the surface
c) Not move
d) First move with a constant velocity for sometime and then will have accelerated motion

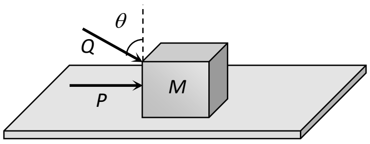
65. A block rests on a rough inclined plane making an angle of 30° with the horizontal. The coefficient of static friction between the block and the plane is 0.8. If the frictional force on the block is 10 N, the mass of the block (in kg) is (take $g = 10\ m/s^2$)
a) 2.0 b) 4.0 c) 1.6 d) 2.5

66. A particle moves in the xy- plane under the action of a force $\boldsymbol{F}$suchthat thecomponents of its linearmomentum $\boldsymbol{p}$at any time t are $p_x = 2\cos t$, $p_y = 2\sin t$. The angle between $\boldsymbol{F}$and$\boldsymbol{p}$at time t is
a) 90° b) 0° c) 180° d) 30°

67. A car is moving along a straight horizontal road with a speed v_0. If the coefficient of friction between the tyres and the road is μ, the shortest distance in which the car can be stopped is
a) $\frac{v_0^2}{2\mu g}$ b) $\frac{v_0}{\mu g}$ c) $\left(\frac{v_0}{\mu g}\right)^2$ d) $\frac{v_0}{\mu}$

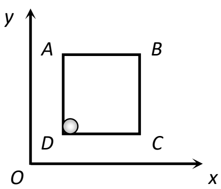
68. When the speed of a moving body is doubled
a) Its acceleration is doubled
b) Its momentum is doubled
c) Its kinetic energy is doubled
d) Its potential energy is doubled

69. A block of mass m lying on a rough horizontal plane is acted upon by a horizontal force P and another force Q inclined at an angle θ to the vertical. The block will remain in equilibrium, if the coefficient of friction between it and the surface is



a) $\frac{(P + Q\sin\theta)}{(mg + Q\cos\theta)}$ b) $\frac{(P\cos\theta + Q)}{(mg - Q\sin\theta)}$ c) $\frac{(P + Q\cos\theta)}{(mg + Q\sin\theta)}$ d) $\frac{(P\sin\theta - Q)}{(mg - Q\cos\theta)}$

70. A solid sphere of mass 2 kg is resting inside a cube as shown in the figure. The cube is moving with a velocity $v = (5t\hat{i} + 2t\hat{j})m/s$. Here t is the time in second. All surface are smooth. The sphere is at rest with respect to the cube. What is the total force exerted by the sphereon the cube. (Take $g = 10\ m/s^2$)



a) $\sqrt{29}N$ b) $29\ N$ c) $26\ N$ d) $\sqrt{89}N$

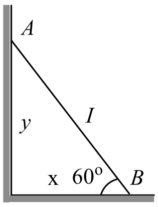
71. In an elevator moving vertically up with an acceleration g, the force exerted on the floor by a passenger of mass M is

a) Mg b) $\frac{1}{2}Mg$ c) Zero d) $2\ Mg$

72. A 2 kg block is lying on a smooth table which is connected by a body of mass 1 kg by a string which passes through a pulley. The 1 kg mass is hanging vertically. The acceleration of block and tension in the string will be

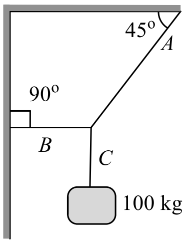
a) $3.27 m/s^2, 6.54\ N$ b) $4.38 m/s^2, 6.54\ N$ c) $3.27 m/s^2, 9.86\ N$ d) $4.38 m/s^2, 9.86\ N$

73. A rod length AB is moving with ends remaining in contact with frictionless wall and floor. If at the instant shown, the velocity of end B is 3 ms^{-1} towards negative x-direction, then magnitude of velocity of end A will be



a) $3\ \text{ms}^{-1}$ b) $\sqrt{3}\ \text{ms}^{-1}$ c) $1.5\ \text{ms}^{-1}$ d) $2\ \text{ms}^{-1}$

74. A 100 kg block is suspended with the help of three string A, B and C. The tension in the string C is

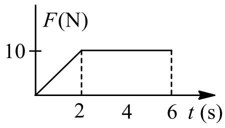


a) 50 gN b) 100 gN c) 20 gN d) 20 gN

75. A shell at rest at the origin explodes into three fragments of masses 1 kg, 2kg and mkg. The 1 kg and 2 kg pieces fly off with speeds off $5ms^{-1}$ along x-axis and $6ms^{-1}$ along y-axis respectively. If the mkg piece files off with a speed of 6.5 ms^{-1}, the total mass of the shell must be

a) 4 kg b) 5 kg c) 3.5 kg d) 4.5 kg

76. A body of mass 3 kg is acted on by a force which varies as shown in the graph below. The momentum acquired is given by



a) Zero b) 5 N-s c) 30 N-s d) 50 N-s

77. A rocket with a lift-off mass 10^5 kg is blasted upward with an initial acceleration of 5 ms^{-2}. If $\text{g} = 10\ \text{ms}^{-2}$, then the initial thrust of the blast is

a) 1.5×10^2N b) 1.5×10^3N c) 1.5×10^5N d) 1.5×10^6N

78. A monkey of mass 20 kg is holding a vertical rope.The rope will not break when a mass of 25 kg is suspended from it but will break if the mass exceeds 25 kg. What is the maximum acceleration with which the monkey can climb up along the rope ($g = 10\ m/s^2$)

a) 10 m/s^2 b) 25 m/s^2 c) 2.5 m/s^2 d) 5 m/s^2

79. A satellite in force-free space sweeps stationary interplanetary dust at rate

$$\frac{dM}{dt} = \alpha v,$$

where M is the mass, v is the velocity of satellite and α is a constant

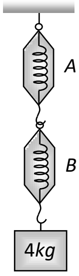
What is the deceleration of the satellite?

a) $\frac{-2\alpha v^2}{M}$ b) $-\alpha v^2/M$ c) $-\alpha v^2$ d) $\frac{\alpha v^2}{M}$

80. A car starts from rest to cover a distance s. The coefficient of friction between the road and the tyres is μ. The minimum time in which the car can cover the distance is proportional to

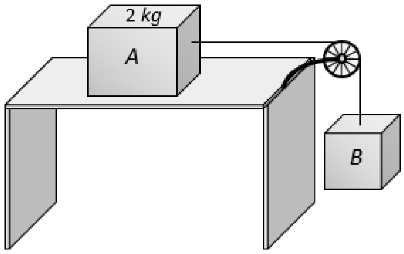
a) μ b) $\sqrt{\mu}$ c) $1/\mu$ d) $1/\sqrt{\mu}$

81. A block of mass 4 kg is suspended through two light spring balances A and B. Then A and B, Then A and B will read respectively



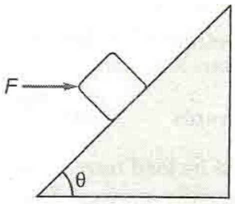
a) 4 kg and zero kg b) Zero kg and 4 kg c) 4 kg and 4 kg d) 2 kg and 2 kg

82. The coefficient of static friction, μ_s, between block A of mass 2 kg and the table as shown in the figure is 0.2. What would be the maximum mass value of block B so that the two blocks do not move? The string and the pulley are assumed to be smooth and massless ($g = 10\ m/s^2$)



a) 2.0 kg b) 4.0 kg c) 0.2 kg d) 0.4 kg

83. A horizontal force F is applied on a block mass m placed on a rough inclined plane of inclination θ. The normal reaction N is



a) $mg \cos\theta$ b) $mg \sin\theta$ c) $mg \cos\theta - F \cos\theta$ d) $mg \cos\theta + F \sin\theta$

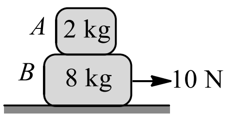
84. A block can slide on a smooth inclined plane of inclination θ kept on the floor of a lift. When the lift is descending with a retardation a, the acceleration of the block relative to the incline is

a) $(g + a) \sin\theta$ b) $(g - a)$ c) $g \sin\theta$ d) $(g - a) \sin\theta$

85. Two masses m_1 and m_2 ($m_1 > m_2$) are connected by massless flexible and inextensible string passed over massless and frictionless pulley. The acceleration of centre of mass is

a) $\left(\frac{m_1 - m_2}{m_1 + m_2}\right)^2 g$ b) $\frac{m_1 - m_2}{m_1 + m_2} g$ c) $\frac{m_1 + m_2}{m_1 - m_2} g$ d) Zero

86. Block A of mass 2 kg is placed over a block B of mass 8 kg. The combination is placed on a rough horizontal surface. If $g = 10\text{ms}^{-2}$, coefficient of friction between B and floor =0.5, coefficient of friction between A and $B = 0.4$ and a horizontal force of 10 N is applied on 8 kg block, then the force of friction between A and B is



a) 100 N b) 50 N c) 40 N d) None of these

87. A flat plate moves normally with a speed v_1 towards a horizontal jet of water of uniform area of cross-section. The jet discharges water at the rate of volume V per second at a speed of v_2. The density of water is ρ. Assume that water splashes along the surface of the plate at right angles to the original motion. The

magnitude of the force acting on the plate due to the jet of water is

a) $\rho V v_1$ b) $\rho V(v_1+v_2)$ c) $\frac{\rho V}{v_1+v_2} v_1^2$ d) $\rho\left[\frac{V}{v_2}\right](v_1+v_2)^2$

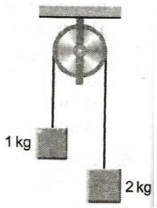
88. The rate of the mass of the gas emitted from rear of a rocket is initially 0.1kgs^{-1}. If the speed of the gas relative to the rocket is 50 ms^{-1} and mass of the rocket is 2 kg, then the acceleration of the rocket (in ms^{-2}) is

a) 5 b) 5.2 c) 2.5 d) 25

89. A cricket ball of mass 0.25 kg with speed 10 m/s collides with a bat and returns with same speed with in 0.01 s. The force acted on bat is

a) 25 N b) 50 N c) 250 N d) 500 N

90. Two blocks of masses 1 kg and 2 kg are connected by a metal wire going over a smooth pulley as shown in figure. The breaking stress of the metal is $2 \times 10^9 \text{Nm}^{-2}$. What should be the minimum radius of the wire used if it is not to break? Take $g = 10 \text{ ms}^{-2}$



a) 4.6×10^{-5}m b) 4.6×10^{-6} m c) 2.5×10^{-6}m d) 2.5×10^{-5}m

91. A stone weighing 1 kg and sliding on ice with a velocity of 2 m/s is stopped by friction in 10 sec.The force of friction (assuming it to be constant) will be

a) -20 N b) -0.2 N c) 0.2 N d) 20 N

92. Diwali rockets are ejecting 50 g of gases per second at a velocity of 400 ms^{-1}. The accelerating force on the rocket will be

a) 22 dyne b) 20 N c) 20 dyne d) 100 N

93. A block moving on a surface with velocity 20 ms^{-1} comes to rest because of surface friction over a distance of 40 m. taking $g = 10 \text{ ms}^{-2}$, the coefficient of dynamic friction is

a) 0.5 b) 0.3 c) 0.2 d) 0.1

94. A student unable to answer a question on Newton's law of motion attempts to pull himself up by tugging on his hair. He will not succeed

a) As the force exerted is small
b) The frictional force while gripping, is small
c) Newton's law of inertia is not applicable to living beings
d) As the force applied is internal to the system

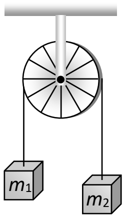
95. A uniform metal chain is placed on a rough table such that one end of it hangs down over the edge of the table. When one-third of its length hangs over the edge, the chain starts sliding. Then, the coefficient of static friction is

a) 3/4 b) 1/4 c) 2/3 d) 1/2

96. The mass of a body measured by a physical balance in the lift at rest is found to be m. If the lift is going up with an acceleration a, its mass will be measured as

a) $m\left(1-\frac{a}{g}\right)$ b) $m\left(1+\frac{a}{g}\right)$ c) m d) Zero

97. Two masses $m_1 = 5\ kg$ and $m_2 = 4.8\ kg$ tied to a string are hanging over a light frictionless pulley. What is the acceleration of the masses when they are free to move ($g = 9.8\ m/s^2$)



a) 0.2 m/s^2 b) 9.8 m/s^2 c) 5 m/s^2 d) 4.8 m/s^2

98. If rope of lift breaks suddenly, the tension exerted by the surface of lift
(a =acceleration of lift)
a) mg b) $m(g+a)$ c) $m(g-a)$ d) 0

99. A light string passing over a smooth light pulley connects two blocks of masses m_1 and m_2 (vertically). If the acceleration of the system is (g/8), then the ratio of masses is
a) 8 : 1 b) 9 : 7 c) 4 : 3 d) 5 : 3

100. If a body of mass m is carried by a lift moving with an upward acceleration a, then the forces acting on the body are (i) the reaction R on the floor of the lift upwards (ii) the weight mg of the body acting vertically downwards. The equation of motion will be given by
a) $R=mg-ma$ b) $R=mg+ma$ c) $R=ma-mg$ d) $R=mg\times ma$

101. A bird is sitting in a large closed cage which is placed on a spring balance. It records a weight of 25 N. The bird (mass $m=0.5\ kg$) files upward in the cage with an acceleration of 2 m/s^2. The spring balance will now record a weight of
a) 24 N b) 25 N c) 26 N d) 27 N

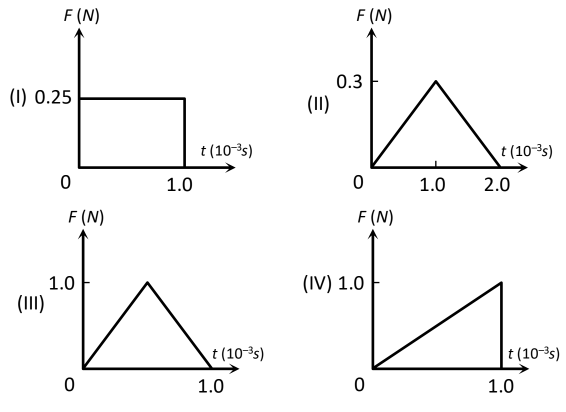
102. A body weight 8 g when placed in one pan and 18 g when placed on the other pan of a false balance. If the beam is horizontal when both the pans are empty. The true weight of the body is
a) 13 g b) 12 g c) 15.5 g d) 15 g

103. A block of mass 5 kg is on a rough horizontal surface and is at rest. Now a force of 24 N is imparted to it with negligible impulse. If the coefficient of kinetic friction is 0.4 and $g=9.8\ m/s^2$, then the acceleration of the block is
a) 0.26 m/s^2 b) 0.39 m/s^2 c) 0.69 m/s^2 d) 0.88 m/s^2

104. A cork is submerged in water by a spring attached to the bottom of a pail. When the pail is kept in a elevator moving with an acceleration downwards, the spring length
a) Increases b) Decreases c) Remains unchanged d) Data insufficient

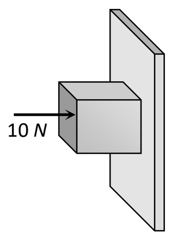
105. The maximum speed of a car on a road turn of radius 30 m; if the coefficient of friction between the tyres and the road is 0.4; will be
a) 9.84 m/s b) 10.84 m/s c) 7.84 m/s d) 5.84 m/s

106. Figures I, II, III and IV depict variation of force with time



The impulse is highest in the case of situations depicted. Figure
a) I and II b) III and I c) III and IV d) IV only

107. A horizontal force of 10 N is necessary to just hold a block stationary against a wall. The coefficient of friction between the block and the wall is 0.2. The weight of the block is



a) 2 N b) 20 N c) 50 N d) 100 N

108. A body of mass 10 kg slides along a rough horizontal surface. The coefficient of friction is $1/\sqrt{3}$. Taking

$g = 10\ m/s^2$, the least force which acts an angle of 30° to the horizontal is

a) 25 N b) 100 N c) 50 N d) $\frac{50}{\sqrt{3}} N$

109. A player caught a cricket ball of mass 150 gmmoving at the rate of 20 m/sec. If the catching process be completed in 0.1 sec the force of the blow exerted by the ball on the hands of player is

a) 0.3 N b) 30 N c) 300 N d) 3000 N

110. A lift is moving down with acceleration$a$. A man in the lift drops a ball inside the lift. The acceleration of the ball as observed by the man in the lift and a man standing stationary on the ground are respectively

a) g, g b) g − a, g − a c) g − a, g d) a, g

111. A force of 10Newton acts on a body of mass 20 kg for 10 seconds. Change in its momentum is

a) 5 kgm/s b) 100 kgm/s c) 200 kgm/s d) 1000 kgm/s

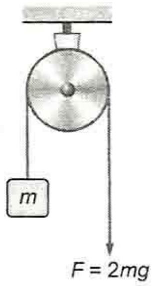
112. A man weighs 80 kg. He stands on a weighing scale in a lift which is moving upwards with a uniform acceleration of $5 m/s^2$. What would be the reading on the scale. ($g = 10\ m/s^2$)

a) 400 N b) 800 N c) 1200 N d) Zero

113. The coefficient of kinetic friction between a 20 kg box and the floor is 0.40. How much work does a pulling force do on the box in pulling it 8.0 m across the floor at constant speed? The pulling force is directed 37° above the horizontal

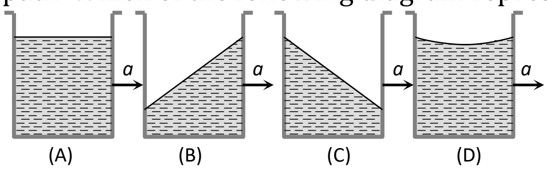
a) 343 J b) 482 J c) 14.4 J d) None of these

114. In the arrangement shown in figure, if a force 2 mg is applied at the free end of the rope, the mass m will ascend with an acceleration of



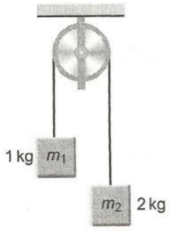
a) $\frac{g}{3}$ b) $\frac{g}{2}$ c) g d) 2 g

115. A vessel containing water is given a constant acceleration a towards the right, along a straight horizontal path. Which of the following diagram represents the surface of the liquid



a) A b) B c) C d) D

116. Two masses $m_1 = 1$kg and $m_2 = 2$kg are connected by a light inextensible string and suspended by means of a weightless pulley as shown in figure.



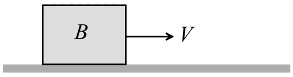
Assuming that both the masses start from rest, the distance travelled by the centre of mass in 2 s is (take $g = 10 \mathrm{m/s^2}$)

a) $\frac{20}{9}$m b) $\frac{40}{9}$m c) $\frac{2}{3}$m d) $\frac{1}{3}$m

117. A body is coming with a velocity of 72 $\mathrm{kmh^{-1}}$ on a rough horizontal surface of coefficient of friction 0.5. If the acceleration due to gravity is 10 $\mathrm{ms^{-2}}$, find the minimum distance it can be stopped

a) 400 m b) 40 m c) 0.40 m d) 4 m

118. A block B is pushed momentarily along a horizontal surface with an initial velocity V. If μ is the coefficient of sliding friction between B and the surface, block B will come to rest after a time



a) $V/(g\mu)$ b) $g\mu/V$ c) g/V d) V/g

119. A mass of 6 kg is suspended by a rope of length 2 m from a ceiling. A force of 50 N is applied in the horizontal direction at the mid-point of the rope. The angel made by the rope, with the vertical, in equilibrium position will be (take $g = 10\ ms^{-2}$, neglect the mass of the rope)

a) 90° b) 60° c) 50° d) 40°

120. The average force necessary to stop a bullet of mass 20 g moving with a speed of 250 m/s, as it penetrates into the wood for a distance of 12 cm is

a) $2.2 \times 10^3 N$ b) $3.2 \times 10^3 N$ c) $4.2 \times 10^3 N$ d) $5.2 \times 10^3 N$

121. A ball of mass 0.2 kg is thrown vertically upward by applying a force by hand. If the hand moves 0.2 m while applying the force and the ball goes up to 2 m height further, find the magnitude of the force. Consider $g = 10ms^{-2}$

a) 4 N b) 16 N c) 20 N d) 22 N

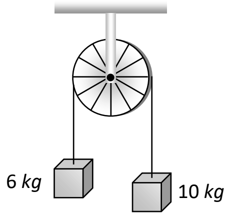
122. Which one of the following is not a contact force

a) Viscous force b) Air resistance c) Friction d) Magnetic force

123. A block of mass 50 kg slides over a horizontal distance of 1m. If the coefficient of friction between their surface is 0.2, then work done against friction is

a) 98 J b) 72 J c) 56 J d) 34 J

124. A light string passes over a frictionless pulley. To one of its ends a mass of 6 kg is attached. To its other end a mass of 10 kg is attached. The tension in the thread will be

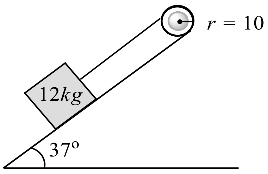


a) 24.5 N b) 2.45 N c) 79 N d) 73.5 N

125. A machine gun fires a bullet of mass 40 g with a velocity 1200 ms^{-1} . The man holding it can exert a maximum force of 144 N on the gun. How many bullets can he fire per second at the most

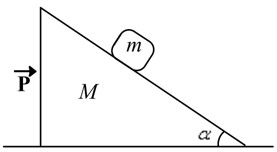
a) One b) Four c) Two d) Three

126. A body shown in figure is accelerating downward with acceleration 2 m/s^2. The tension in the string is



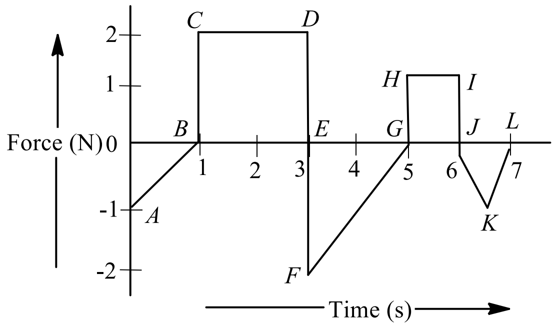
a) 48 N b) 50 N c) 30 N d) 42 N

127. A wooden wedge of mass M and inclination angle α rests on a smooth floor. A block of mass m is kept on wedge. A force $\vec{\mathbf{P}}$ is applied on the wedge as shown in figure, such that a block remains stationary with respect to wedge. The magnitude of force $\vec{\mathbf{P}}$ is



a) $(M+m)g\tan\alpha$ b) $g \tan \alpha$ c) $mg\cos\alpha$ d) $(M+m)g\,\text{cosec}\,\alpha$

128. A force-time graph for a linear motion of a body is shown in the figure. The change in linear momentum between 0 and 7 s is



a) 2 Ns b) 3 Ns c) 4 Ns d) 5 NS

129. A piece of wire is bent in the shape of a parabola $y = kx^2$ (y-axis vertical) with a bead of mass m on it. The bead can slide on the wire without friction. It stays at the lowest point of the parabola when the wire is at rest. The wire is now accelerated parallel to the x-axis with a constant acceleration$a$. The distance of the new equilibrium position of the bead, where the bead can stays at rest with respect to the wire, from the y-axis is

a) $\frac{a}{gk}$ b) $\frac{a}{2gk}$ c) $\frac{2a}{gk}$ d) $\frac{a}{4gk}$

130. A gun fires bullet each of mass 1 g with velocity of 10 ms^{-1} by exerting a constant force of 5 g weight. Then the number of bullets fired per second is
(Take $g = 10\ \text{ms}^{-2}$)

a) 50 b) 5 c) 10 d) 25

131. The backside of a truck is open and a box of 40 kg is placed 5m away from the rear end. The coefficient of friction of the box with the surface of the truck is 0.15. The truck starts from rest with 2 m/s^2acceleration. Calculate the distance covered by the truck when the box falls off

a) 20 m b) 30 m c) 40 m d) 50 m

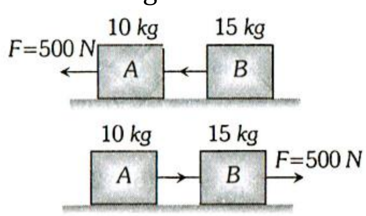
132. In the first second of its flight, rocket ejects 1/60 of its mass with a velocity of 2400 ms^{-1}. The acceleration of the rocket is

a) 19.6 ms^{-2} b) 30.2 ms^{-2} c) 40 ms^{-2} d) 49.8 ms^{-2}

133. A stationary body of mass 3 kg explodes into three equal pieces. Two of the pieces fly off in two mutually perpendicular directions, one with velocity of $3\,\hat{\mathbf{i}}\text{ms}^{-1}$ and the other with a velocity of $4\,\hat{\mathbf{j}}\text{ms}^{-1}$. If the explosion occurs in 10^{-4}s, the force acting on the third piece in newtons is

a) $(3\,\hat{\mathbf{i}} + 4\,\hat{\mathbf{j}}) \times 10^{-4}$ b) $(3\,\hat{\mathbf{i}} - 4\,\hat{\mathbf{j}}) \times 10^{-4}$ c) $(3\,\hat{\mathbf{i}} + 4\,\hat{\mathbf{j}}) \times 10^{4}$ d) $-(3\,\hat{\mathbf{i}} + 4\,\hat{\mathbf{j}}) \times 10^{4}$

134. Two bodies A and B of masses 10 kg and 15 kg respectively kept on a smooth, horizontal surface are tied to the ends of a light string. If T represents the tension in the spring when a horizontal force $F = 500\ N$ is applied to A (as shown in figure 1) and T$''$ be the tension when it is applied to B (figure 2), then which of the following is true



a) $T = T' = 500\ N$ b) $T = T' = 250\ N$
c) $T = 200\ N, T' = 300\ N$ d) $T = 300N, T' = 200\ N$

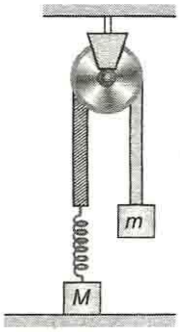
135. A bullet of mass 10 g moving with 300 ms^{-1} hits a block of ice of mass 5 kg and drops dead. The velocity of ice is

a) 50 cm/s b) 60 cm/s c) 40 cm/s d) 200 cm/s

136. A force of 98 N is required to just start moving a body of mass 100 kg over ice. The coefficient of static friction is

a) 0.6 b) 0.4 c) 0.2 d) 0.1

137. A boy having a mass equal to 40 $kilograms$ is standing in an elevator. The force felt by the feet of the boy will be greatest when the elevator
($g = 9.8\ metres/\sec^2$)
a) Stands still
b) Moves downward at a constant velocity of 4 $metres/sec$
c) Accelerates downward with an acceleration equal to 4 $metres/\sec^2$
d) Accelerates upward with an acceleration equal to 4 $metres/\sec^2$
138. The motion of a rocket is based on the principle of conservation of
a) Mass b) Kinetic energy c) Linear momentum d) Angular momentum
139. A body of mass 2 kg is being dragged with uniform velocity of 2 m/s on a rough horizontal plane. The coefficient of friction between the body and the surface is 0.20. The amount of heart generated in 5 sec is
($J = 4.2\ joule/cal$ and $g = 9.8\ m/s^2$)
a) 9.33 cal b) 10.21 cal c) 12.67 cal d) 13.34 cal
140. The sum of the magnitudes of two forces acting at a point is 18 N and the magnitude of their resultant is 12 N. If the resultant is at 90° with the smaller force, the magnitude of the forces in N are
a) 6,12 b) 11,7 c) 5,13 d) 14,4
141. In the figure, the ball A is released from rest when the spring is at its natural length. For the block B of mass M to leave contact with the ground at same stage, the minimum mass of A must be



a) $2M$
b) M
c) $\frac{M}{2}$
d) A function of M and the force constant of the spring
142. The engine of a jet aircraft applies a thrust force of $10^5 N$ during take off and causes the plane to attain a velocity of 1 km/sec in 10 sec. The mass of the plane is
a) $10^2 kg$ b) $10^3 kg$ c) $10^4 kg$ d) $10^5 kg$
143. A block is kept on an inclined plane of inclination θ and length l. The velocity of particle at the bottom of incline is (the coefficient of friction is μ)
a) $\sqrt{2gl(\mu\cos\theta - \sin\theta)}$ b) $\sqrt{2gl(\sin\theta - \mu\cos\theta)}$
c) $\sqrt{2gl(\sin\theta + \mu\cos\theta)}$ d) $\sqrt{2gl(\cos\theta - \mu\sin\theta)}$
144. A body of mass 2 kg is kept by pressing to a vertical wall by a force of 100 N. The friction between wall and body is 0.3. Then the frictional force is equal to
a) 6 N b) 20 N c) 600 N d) 700 N
145. A blumb bob is hung from the ceiling of a train compartment. The train moves on an inclined track of inclination 30° with horizontal. Acceleration of train up the plane is $a = 9/2$. The angle which the string supporting the bob makes with normal to the ceiling in equilibrium is
a) 30° b) $\tan^{-1}\left(\frac{2}{\sqrt{3}}\right)$ c) $\tan^{-1}\left(\frac{\sqrt{3}}{2}\right)$ d) $\tan^{-1}(2)$
146. Which of the following quantities measured from different inertial reference frames are same?
a) Force b) Velocity c) Displacement d) Kinetic energy
147. A block of mass ‘m’ is connected to another block of mass ‘M’ by a spring (massless) of spring constant ‘K’.

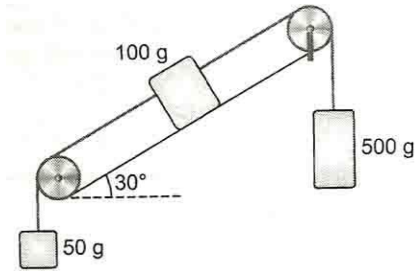
The blocks are kept on a smooth horizontal plane. Initially the blocks are at rest and the spring is unstretched. Then a constant force 'F' starts acting on the block of mass 'M' to pull it. Find the force on the block of mass 'm'

a) $\frac{mF}{M}$ b) $\frac{(M + mF)}{m}$ c) $\frac{mF}{(m + M)}$ d) $\frac{MF}{(m + M)}$

148. If in a stationary lift, a man is standing with a bucket full of water, having a hole at its bottom. The rate of flow of water through this hole is R_0. If the lift starts to move up and down with same acceleration and then that rates of flow of water are R_u and R_d, then

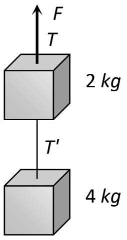
a) $R_0 > R_u > R_d$ b) $R_u > R_0 > R_d$ c) $R_d > R_0 > R_u$ d) $R_u > R_d > R_0$

149. The acceleration of the 500 g block in figure is



a) $\frac{6g}{13}$ downwards b) $\frac{7g}{13}$ downwards c) $\frac{8g}{13}$ downwards d) $\frac{9g}{13}$ upwards

150. Two blocks are connected by a string as shown in the diagram. The upper block is hung by another string. A force F applied on the upper string produces an acceleration of $2\ m/s^2$ in the upward direction in both the blocks. If T and T' be the tensions in the two parts of the string, then ($g = 9.8\ m/s^2$)



a) $T = 70.8\ N$ and $T' = 47.2\ N$ b) $T = 58.8\ N$ and $T' = 47.2\ N$
c) $T = 70.8\ N$ and $T' = 58.8\ N$ d) $T = 70.8\ N$ and $T' = 0$

151. A body takes time t to reach the bottom of an inclined plane of angle θ with the horizontal. If the plane is made rough, time taken now is $2t$. The coefficient of the friction of the rough surface is

a) $\frac{3}{4}\tan\theta$ b) $\frac{2}{3}\tan\theta$ c) $\frac{1}{4}\tan\theta$ d) $\frac{1}{2}\tan\theta$

152. A body of mass M at rest explodes into three pieces, two of which of mass $M/4$ each are thrown off in perpendicular directions with velocities of $3\ m/s$ and $4\ m/s$respectively. The third piece will be thrown off with a velocity of

a) $1.5\ m/s$ b) $2.0\ m/s$ c) $2.5\ m/s$ d) $3.0\ m/s$

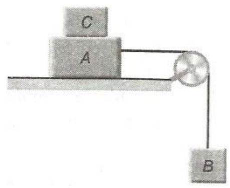
153. A block at rest slides down a smooth inclined plane which makes an angle 60° with the vertical and it reaches the ground in t_1 second. Another block is dropped vertically from the same point and reaches the ground in t_2 second. Then the ratio of $t_1 : t_2$ is

a) 1:2 b) 2:1 c) 1:3 d) $1:\sqrt{2}$

154. The time period of a simple pendulum measured inside a stationary lift is found to be T. If the lift starts accelerating upwards with an acceleration $g/3$, the time period is

a) $T\sqrt{3}$ b) $T\sqrt{3}/2$ c) $T/\sqrt{3}$ d) $T/3$

155. Two masses A and B of 15 kg and 10 kg are connected with a string passing over a frictionless pulley fixed at the corner of a table (as shown in figure). The coefficient of friction between the table and block is 0.4. The minimum mass of C, that may be placed on A to prevent it from moving is



a) 10 kg b) 5 kg c) Zero d) 15 kg

156. A 60 kg man stands on a spring scale in the lift. At some instant he finds, scale reading has changed from 60 kg to 50 kg for a while and then comes back to the original mark. What should we conclude

a) The lift was in constant motion upwards
b) The lift was in constant motion downwards
c) The lift while in constant motion upwards, is stopped suddenly
d) The lift while in constant motion downwards, is suddenly stopped

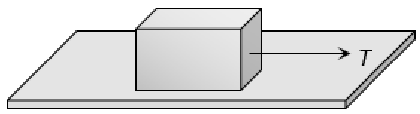
157. The mass of ship is $2 \times 10^7 kg$. On applying a force of $25 \times 10^5 N$, it is displaced through 25 m. After the displacement, the velocity acquired by the ship will be

a) 12.5 m/s b) 5 m/s c) 3.7 m/s d) 2.5 m/s

158. 300 $joule$ of work is done in sliding up a 2 kg block on an inclined plane to a height of 10 $metres$. Taking value of acceleration due to gravity 'g' to be 10 m/s^2, work done against friction is

a) 100 J b) 200 J c) 300 J d) Zero

159. In the figure shown, a block of weight 10 N is resting on a horizontal surface. The coefficient of static friction between the block and the surface $\mu_s = 0.4$. A force of 3.5 N will keep the block in uniform motion, once it has been set in motion. A horizontal force of 3N is applied to the block then the block will



a) Move over the surface with constant velocity
b) Move having accelerated motion over the surface
c) Not move
d) First it will move with a constant velocity for some time and then will have accelerated motion

160. Rocket engines lift a rocket from the earth surface because hot gas with high velocity

a) Push against the earth b) Push against the air
c) React against the rocket and push it up d) Heat up the air which lifts the rocket

161. A force of 20N is applied on a body of mass 5 kg resting on a horizontal plane. The body gains a kinetic energy of 10 $joule$ after it moves a distance 2 m. The frictional force is

a) 10 N b) 15 N c) 20 N d) 30 N

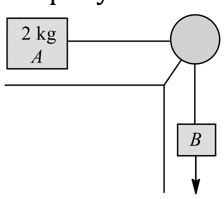
162. The resultant force of 5 N and 10 N can not be

a) 12 N b) 8 N c) 4 N d) 5 N

163. A boy of mass 100 g is sliding from an inclined plane of inclination 30°. What is the frictional force experienced if $\mu = 1.7$

a) $1.7 \times \sqrt{2} \times \frac{1}{\sqrt{3}} N$ b) $1.7 \times \sqrt{3} \times \frac{1}{2} N$ c) $1.7 \times \sqrt{3} N$ d) $1.7 \times \sqrt{2} \times \frac{1}{3} N$

164. The coefficient of static friction μ_s between block A of mass 2 kg and the table as shown in the figure is 0.2. What would be the maximum mass value of block B so that the two blocks do not move? The string and the pully are assumed to be smooth and massless ($g = 10 \text{ ms}^{-2}$)



a) 2.0 kg b) 4.0 kg c) 0.2 kg d) 0.4 kg

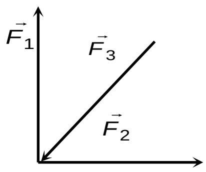
165. Work done by a frictional force is

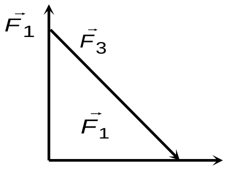
a) Negative b) Positive c) Zero d) All of the above

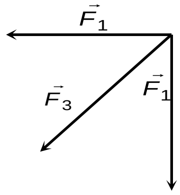
166. A force of 19.6 N when applied parallel to the surface just moves a body of mass 10 kg kept on a horizontal surface. If a 5 kg mass is kept on a horizontal surface. If a 5 kg mass is kept on the first mass, the force applied parallel to the surface to just move the combined body is

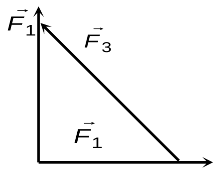
a) 29.4 N b) 39.2 N c) 18.6 N d) 42.6 N

167. Which of the four arrangements in the figure correctly shows the vector addition of two forces $\overrightarrow{F_1}$ and $\overrightarrow{F_2}$ to yield the third force $\overrightarrow{F_3}$

a) 

b) 

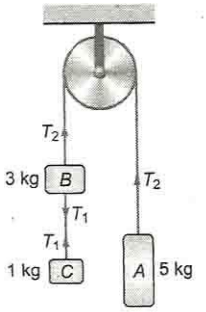
c) 

d) 

168. A smooth block is released at rest on a 45° incline and then slides a distance d. The time taken to slide is n times as much to slide on rough incline than on a smooth incline. The coefficient of friction is

a) $\mu_k = 1 - \frac{1}{n^2}$ b) $\mu_k = \sqrt{1 - \frac{1}{n^2}}$ c) $\mu_s = 1 - \frac{1}{n^2}$ d) $\mu_s = \sqrt{1 - \frac{1}{n^2}}$

169. Refer to the system shown in figure. The acceleration of the masses is

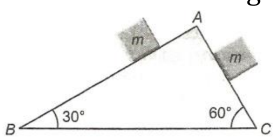


a) $\frac{g}{3}$ b) $\frac{g}{6}$ c) $\frac{g}{9}$ d) $\frac{g}{12}$

170. A 1000 kg lift is supported by a cable that can support 2000 kg. The shortest distance in which the lift can be stopped when it is descending with a speed of 2.5 ms^{-1} is [Take g = 10 ms^{-2}]

a) 1 m b) 2 m c) $\frac{5}{32}$m d) $\frac{5}{16}$m

171. Two blocks of equal masses m are released from the top of a smooth fixed wedge as shown in the figure.



The acceleration of the centre of mass of the two blocks is

a) g b) $\frac{g}{2}$ c) $\frac{3g}{4}$ d) $\frac{g}{\sqrt{2}}$

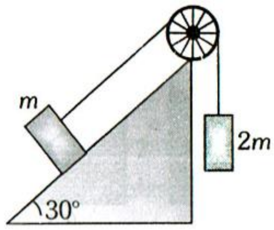
172. A given object taken n times as much time to slide down a 45° rough incline as it takes to slide down a perfectly smooth 45° incline. The coefficient of kinetic friction between the object and the incline is given by

a) $\left(1 - \frac{1}{n^2}\right)$ b) $\frac{1}{1-n^2}$ c) $\sqrt{\left(1 - \frac{1}{n^2}\right)}$ d) $\sqrt{\frac{1}{1-n^2}}$

173. The minimum force required to move a body up an inclined plane is three times the minimum force required to prevent it from sliding down the plane. If the coefficient of friction between the body and the inclined plane is $\frac{1}{2\sqrt{3}}$, the angle of the inclined plane is

a) 60° b) 45° c) 30° d) 15°

174. Two blocks of masses m and $2m$ are connected by a light string passing over a frictionless pulley. As shown in the figure, the mass m is placed on a smooth inclined plane of inclination 30° and $2m$ hangs vertically. If the system is released, the blocks move with an acceleration equal to



a) $g/4$ b) $g/3$ c) $g/2$ d) g

175. At a certain instant of time the mass of rocket going up vertically is 100 kg. If it is ejecting 5 kg of gas per second at a speed of 400 m/s, the acceleration of the rocket would be (Taking $g = 10\text{ m/s}^2$)

a) 20 m/s^2 b) 10 m/s^2 c) 2 m/s^2 d) 1 m/s^2

176. A body presses a book against the front wall such that the book does not move. The force of friction between the wall and the book is

a) Towards right b) Towards left c) Downwards d) Upwards

177. Impulse is

a) A scalar b) Equal to change in the momentum of a body
c) Equal to rate of change of momentum of a body d) A force

178. A particle moves in a circular path with decreasing speed. Choose the correct statement

a) Angular momentum remains constant
b) Acceleration $\vec{\mathbf{a}}$ is towards the centre
c) Particle moves in a spiral path with decreasing radius
d) The direction of angular momentum remains constant

179. Observer O_1 is in a lift going upwards and O_2 is on the ground. Both apply Newton's law, and measure normal reaction on the body

a) Both measure the same value b) Both measure zero
c) Both measure different value d) No sufficient data

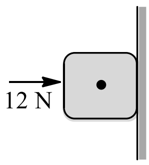
180. A wooden box of mass 8 kg slides down an inclined plane of inclination 30° to the horizontal with a constant acceleration of 0.4 ms^{-2}. What is the force of friction between the box and inclined plane? [$g = 10\text{ ms}^{-2}$]

a) 36.8 N b) 76.8 N c) 65.6 N d) 97.8 N

181. Two weights w_1 and w_2 are suspended from the ends of a light string over a smooth fixed pulley. If the pulley is pulled up with acceleration g, the tension in the string will be

a) $\frac{4w_1w_2}{w_1 + w_2}$ b) $\frac{2w_1w_2}{w_1 + w_2}$ c) $\frac{w_1 - w_2}{w_1 + w_2}$ d) $\frac{w_1w_2}{2(w_1 + w_2)}$

182. A block of weight 5N is pushed against a vertical wall by a force 12N. The coefficient of friction between the wall and block is 0.6. The magnitude of the force exerted by the wall on the block is

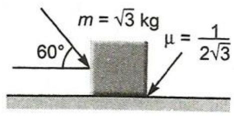


a) 12 N b) 5 N c) 7.2 N d) 13 N

183. A solid disc of mass M is just held in air horizontal by throwing 40 stones per sec vertically upwards to strike the disc each with a velocity 6 ms^{-1}. If the mass of each stone is 0.05 kg. What is the mass of the disc ($g = 10\text{ ms}^{-2}$)

a) 1.2 kg b) 0.5 kg c) 20 kg d) 3 kg

184. What is the maximum value of the force F such that the block shown in the arrangement, does not move?



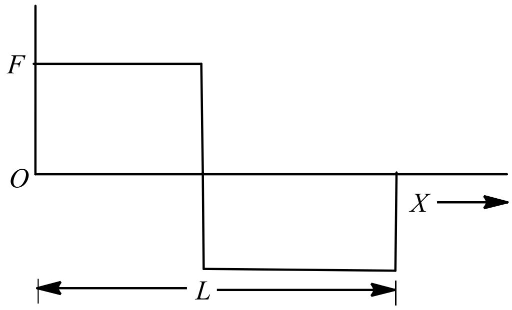
a) 20 N b) 10 N c) 12 N d) 15 N

185. A rocket of mass 100 kg burns 0.1 kg of fuel per sec. If velocity of exhaust gas is 1 km/sec, then it lifts with

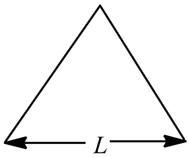
an acceleration of

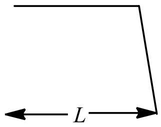
a) $1000\ ms^{-2}$ b) $100\ ms^{-2}$ c) $10\ ms^{-2}$ d) $1\ ms^{-2}$

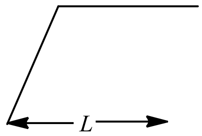
186. A person used force (F), shown in figure move a load with constant velocity on give surface.

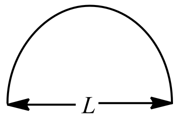


Identify the correct surface profile

a) 

b) 

c) 

d) 

187. A 60 kg man stands on a spring scale in a lift. At some instant he finds that the scale reading has changed from 60 kg to 50 kg for a while and then comes again to 60 kg mark. What should he conclude?

a) The lift was in constant motion upwards
b) The lift was in constant motion downwards
c) The lift while in motion suddenly stopped
d) The lift while in motion upwards suddenly stopped

188. The monkey B shown in figure is holding on to the tail of the monkey A which is climbing up a rope. The masses of the monkeys A and B are 5 kg and 2 kg respectively. If A can tolerate a tension of 30 N in its tail, what force should it apply on the rope in order to carry the monkey B with it? (Take $\mathrm{g} = 10\ \mathrm{ms}^{-2}$)

a) 105 N b) 108 N c) 10.5 N d) 100 N

189. In the above question, if the lift is moving upwards with a uniform velocity, then the frictional resistance offered by the body is

a) Mg b) μMg c) $2\mu Mg$ d) Zero

190. A passenger is travelling in a train moving at 72 kmh^{-1}. His suitcase is kept on the berth. The driver of the train applies brakes such that the speed of the train decreases at a constant rate of 36 kmh^{-1} in 5 s. What should be the minimum coefficient of friction between the suitcase and the berth if the suitcase is not the slide during retardation of the train?

a) $\frac{10}{49}$ b) $\frac{10}{98}$ c) $\frac{28}{49}$ d) $\frac{30}{98}$

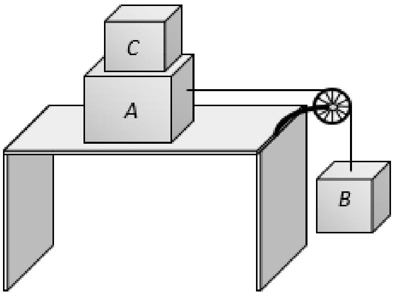
191. An automobile travelling with a speed of 60 km/h, can brake to stop within a distance of 20 m. If the car is going twice at fast, $i.e.$ 120 km/h, the stopping distance will be

a) 20 m b) 40 m c) 60 m d) 80 m

192. A block is lying static on the floor. The maximum value of static frictional force on the block is 10N. If a horizontal force of 8 N is applied to the block, what will be the frictional force on the block

a) 2 N b) 18 N c) 8 N d) 10 N

193. Two masses A and B of 10 kg and 5 kg respectively are connected with a string passing over a frictionless pulley fixed at the corner of a table as shown. The coefficient of static friction of A with table is 0.2. The minimum mass of C that may be placed on A to prevent it from moving is

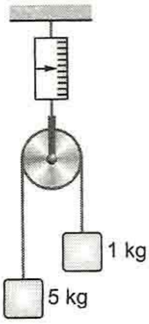


a) 15 kg b) 10 kg c) 5 kg d) 12 kg

194. A body is under the action of two mutually perpendicular forces of 3 N and 4 N. The resultant force acting on the body is

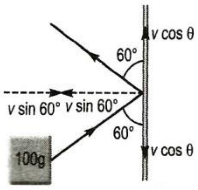
a) 7 N b) 1 N c) 5 N d) Zero

195. In the figure a smooth pulley of negligible weight is suspended by a spring balance. Weights of 1 kg and 5 kg are attached to the opposite ends of a string passing over the pulley and move with acceleration because of gravity. During their motion, the spring balance reads a weight of



a) 6 kg b) Less than 6 kg
c) More than 6 kg d) May be more or less than 6 kg

196. A mass of 100 g strikes the wall with speed 5 ms^{-1} at an angle as shown in figure and it rebounds with the same speed. If the contact time is 2×10^{-3} s, what is the force applied?



a) $250\sqrt{3}$ N to right b) 250 N to right c) $250\sqrt{3}$ N to left d) 250 N to left

197. A block of mass M is attached to the lower end of a vertical spring. The spring is hung from a ceiling and has force constant value k. The mass is released from rest with the spring initially unstretched. The maximum extension produced in the length of the spring will be

a) 1 Mg/k b) $2Mg/k$ c) 4 Mg/k d) $Mg/2k$

198. A particle moves in the $x - y$ plane under the influence of a force such that its linear momentum is
$\vec{p}(t) = A[\hat{\imath}\cos(kt) - \hat{\jmath}\sin(kt)]$
Where $A$and k are constants. The angle between the force and momentum is

a) 0° b) 30° c) 45° d) 90°

199. An open carriage in a goods train is moving with a uniform velocity of 10ms^{-1}. If the rain adds water with zero velocity at the rate of 5 kgs^{-1}, then the additional force applied by the engine to maintain the same velocity of the train is

a) 0.5 N b) 2.0 N c) 50 N d) 25 N

200. A marble block of mass 2 kg lying on ice when given a velocity of 6 ms^{-1} is stopped by friction in 10 s. Then the coefficient of friction is

a) 0.02 b) 0.03 c) 0.06 d) 0.01

201. A stationary bomb explodes into three pieces. One piece of 2 kg mass moves with a velocity of 8 ms^{-1} at right angles to the other piece of mass 1 kg moving with a velocity of 12 ms^{-1}. If the mass of the third

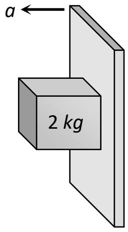
piece is 0.5 kg, then its velocity is

a) 10 ms^{-1} b) 20 ms^{-1} c) 30 ms^{-1} d) 40 ms^{-1}

202. A force of 50 $dynes$ is acted on a body of mass 5 g which is at rest for an interval of 3 seconds, then impulse is

a) $0.15 \times 10^{-3} N-s$ b) $0.98 \times 10^{-3} N-s$ c) $1.5 \times 10^{-3} N-s$ d) $2.5 \times 10^{-3} N-s$

203. A rough vertical board has an acceleration $'a'$ so that a 2 kg block pressing against it does not fall. The coefficient of friction between the block and the board should be



a) $> g/a$ b) $< g/a$ c) $= g/a$ d) $> a/g$

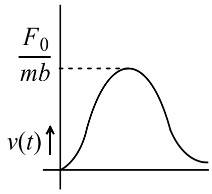
204. A body of mass 10 kg is acted upon by two forces each of magnitude 10 N making an angle of 60° with each other. Find the net acceleration of the body

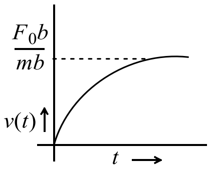
a) $2\sqrt{3}ms^{-2}$ b) $\sqrt{3}ms^{-2}$ c) $3\sqrt{3}ms^{-2}$ d) $4\sqrt{3}ms^{-2}$

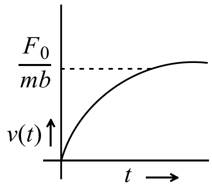
205. A body of mass m collides against a wall with a velocity v and rebounds with the same speed. Its change of momentum is

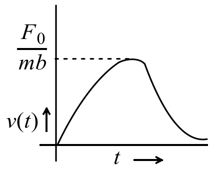
a) $2\,mv$ b) mv c) $-mv$ d) Zero

206. A particle of mass m is at rest at the origin at time $t=0$. It is subjected to a force $F(t)=F_0e^{-bt}$ in the x direction. Its speed $v(t)$ is depicted by which of the following curves

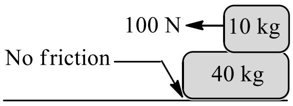
a) 

b) 

c) 

d) 

207. A 40 kg slab rests on a frictionless floor. A 10 kg block rests on top of the slab. The static coefficient of friction between the block and the slab is 0.60 while the kinetic coefficient of friction is 0.40. The 10 kg block is acted upon by a horizontal force of 100 N. If $g = 9.8\ ms^{-2}$, the resulting acceleration of the slab will be



a) $1.47\ ms^{-2}$ b) $1.69\ ms^{-2}$ c) $9.8\ ms^{-2}$ d) $0.98\ ms^{-2}$

208. A block of base 10 cm × 10 cm and height 15 cm is kept on an inclined plane. The coefficient of friction between them is$\sqrt{3}$. The inclination θ of this inclined plane from the horizontal plane is gradually increased from 0°. Then,

a) at $0 = 30°$, the block will start sliding down the plane

b) The block will remain at the rest on the plane up to certain θ and then it will topple

c) At $\theta = 60°$, the block will start sliding down the plane and continue to do so at higher angles

d) At $\theta = 60°$, the block will start sliding down the plane and on further increasing θ, it will topple at certain θ

209. A man is standing at the centre of frictionless pond of ice. How can he get himself to the shore

a) By throwing his shirt in vertically upward direction b) By spitting horizontally

c) He will wait for the ice to melt in pond d) Unable to get at the shore

210. The resultant of two forces acting at an angle of 120° is 10 kg-wt and is perpendicular to one of the forces. That force is

a) $\frac{10}{\sqrt{3}}$kg-wt b) 10 kg-wt c) $20\sqrt{3}$kg-wt d) $10\sqrt{3}$kg-wt

211. A steel wire can withstand a load up to 2940 N. A load of 150 kg is suspended from a rigid support. The maximum angle through which the wire can be displaced from the mean position, so that the wire does not break when the load passes through the position of equilibrium, is

a) 30° b) 60° c) 80° d) 85°

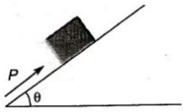
212. A small block slides without friction down an inclined plane starting from rest. Let s_n be the distance travelled from time $t = n - 1$ to $t = n$. Then

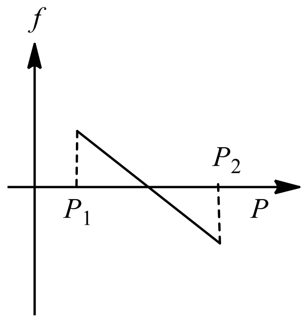
$\frac{s_n}{s_n + 1}$ is

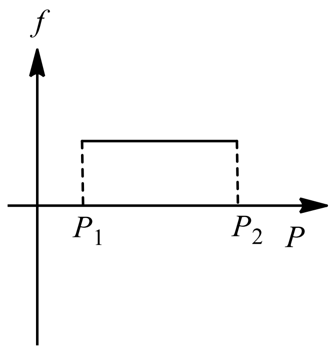
a) $\frac{2n-1}{2n}$ b) $\frac{2n+1}{2n-1}$ c) $\frac{2n-1}{2n+1}$ d) $\frac{2n}{2n+1}$

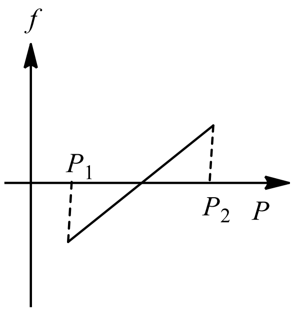
213. A block of mass m is on an inclined plane of angleθ. The coefficient of friction between the block and the plane is μ and $\tan\theta > \mu$. The block is held stationary by applying a force E parallel to the plane. The direction of force pointing up the plane is taken to be positive. As P is varied from $P_1 = mg(\sin\theta - \mu\cos\theta)$ to

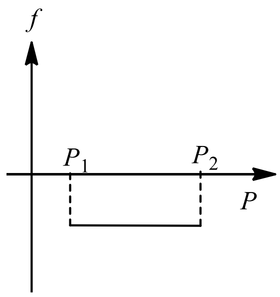
$P_2 = mg(\sin\theta + \mu\cos\theta)$, the frictional force $f versus P$ graph will look like



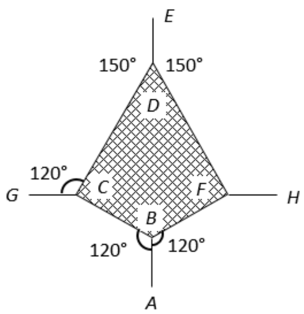
a)


b)


c)


d)


214. The adjacent figure is the part of a horizontally stretched net. Section AB is stretched with a force of 10 N. The tensions in the section BC and BF are



a) 10 N, 11 N

b) 10 N, 6 N

c) 10 N, 10 N

d) Can't calculate due to insufficient data

215. With what minimum acceleration can a fireman slide down a rope while breaking

strength of the rope is $\frac{2}{3}$ of the weight?

a) $\frac{2}{3}g$
b) g
c) $\frac{1}{3}g$
d) Zero

216. A box of mass m kg is placed on the rear side of an open truck accelerating at $t\text{ms}^{-2}$. The coefficient of friction between the box and the surface below it is 0.4. The net acceleration of the box with respect to the truck is zero. The value of m is [Given $\text{g} = 10\ \text{ms}^{-2}$]

a) 4 kg
b) 8 kg
c) 9.78 kg
d) It could be any value

217. A gun fires N bullets per second, each of mass $m$with velocity v. The force exerted by the bullets on the gun is

a) vNm
b) $\frac{mv}{N}$
c) mvN^2
d) $\frac{mv^2}{N}$

218. A person of mass 60 kg is inside a lift of mass 940 kg and presses the button one control panel. The lift starts moving upwards with an acceleration 1.0 m/s^2. If $g = 10\ ms^{-2}$, the tension in the supporting cable is

a) 1200 N
b) 8600 N
c) 9680 N
d) 11000 N

219. A body moves along a circular path of radius 10m and the coefficient of friction is 0.5. What should be its angular speed in rad/s if it is not to slip from the surface ($g = 9.8\ m/s^2$)

a) 5
b) 10
c) 0.1
d) 0.7

220. Which of the following groups of forces could be in equilibrium

a) 3 N, 4 N, 5N
b) 4 N, 5 N, 10 N
c) 30 N, 40 N, 80 N
d) 1 N, 3 N, 5 N

221. A cylinder roll up an inclined plane, reaches some height and then rolls down (without slipping throughout these motions). The directions of frictional force acting on the cylinder are

a) Up the inclined while ascending and down the incline while descending
b) Up the incline while ascending as well as descending
c) Down the incline while ascending and up the incline while descending
d) Down the incline while ascending as well as descending

222. If a person with a spring balance and a body hanging from it goes up and up in an aeroplane, then the reading of the weight of the body as indicated by the spring balance will

a) Go on increasing
b) Go on decreasing
c) First increase and then decrease
d) Remain the same

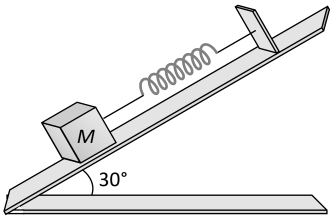
223. Two masses M and $M/2$ are joined together by means of light inextensible string passed over a frictionless pulley as shown in the figure. When the bigger mass is released, the small one will ascend with an acceleration of

a) $\frac{g}{3}$
b) $\frac{3g}{2}$
c) $\frac{g}{2}$
d) g

224. A machine gun mounted on a 2000 kg car on a horizontal frictionless surface fires 10 bullets per second. If 10 g be the mass of each bullet and 500 ms^{-1}, the velocity of each bullet, then the acceleration of the car will be

a) $\frac{1}{10}\text{ms}^{-2}$
b) $\frac{1}{20}\text{ms}^{-2}$
c) $\frac{1}{40}\text{ms}^{-2}$
d) $\frac{1}{60}\text{ms}^{-2}$

225. A body of mass 5 kg is suspended by a spring balance on an inclined plane as shown in figure. The spring balance measure

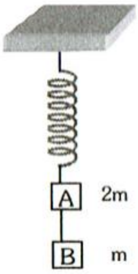


a) 50 N b) 25 N c) 500 N d) 10 N

226. A man of mass 60 kg and a boy mass 30 kg are standing together on frictionless ice surface. If they push each other apart, man moves away with a speed of 0.4 ms^1 relative to ice after 5 s. They will be away from each other at a distance of

a) 9.0 m b) 3.0 m c) 6.0 m d) 30 m

227. Two blocks A and B of masses $2m$ and m, respectively, are connected by a massless and inextensible string. The whole system is suspended by a massless spring as shown in the figure. The magnitudes of acceleration of A and B , immediately after the spring is cut, are respectively

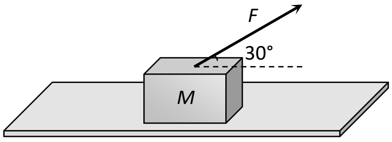


a) $g, g/2$ b) $g/2, g$ c) g, g d) $g/2, g/2$

228. A 5 kg stationary bomb is exploded in three parts having mass 1: 1: 3 respectively. Parts having same mass move in perpendicular directions with velocity $39\mathrm{ms}^{-1}$, then the velocity of bigger part will be

a) $10\sqrt{2}\ \mathrm{ms}^{-1}$ b) $\frac{10}{\sqrt{2}}\mathrm{ms}^{-1}$ c) $13\sqrt{2}\ \mathrm{ms}^{-1}$ d) $\frac{15}{\sqrt{2}}\mathrm{ms}^{-1}$

229. A block of mass $M = 5\ kg$ is resting on a rough horizontal surface for which the coefficient of friction is 0.2. When a force $F = 40\ N$ is applied, the acceleration of the block will be$(g = 10\ ms^2)$



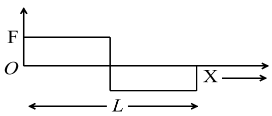
a) 5.73 m/sec^2 b) 8.0 m/sec^2 c) 3.17 m/sec^2 d) 10.0 m/sec^2

230. A body of mass M is kept on a rough horizontal surface (friction coefficient μ). A person is trying to pull the body by applying a horizontal force but the body is not moving. The force by the surface on the body is$F$, where

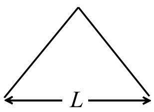
a) $F = Mg$ b) $F = \mu Mgf$

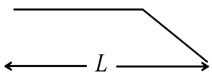
c) $Mg \leq F \leq Mg\sqrt{1+\mu^2}$ d) $Mg \geq F \geq Mg\sqrt{1+\mu^2}$

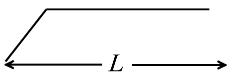
231. A person used force (F), shown in figure to move a load with constant velocity on given surface

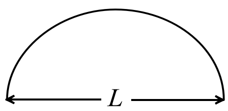


Identify the correct surface profile

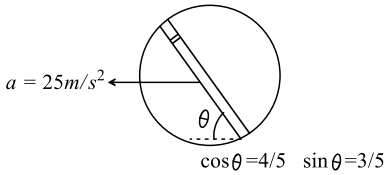
a) 

b) 

c) 

d) 

232. A circular disc with a groove along its diameter is placed horizontally. A block of mass $1kg$ is placed as shown. The co-efficient of friction between the block and all surfaces of groove in contact is $\mu = 2/5$. The disc has an acceleration of 25 m/s^2. Find the acceleration of the block with respect to disc



a) $10\ m/s^2$ b) $5\ m/s^2$ c) $20\ m/s^2$ d) $1\ m/s^2$

233. A body of mass 1.0 kg is falling with an acceleration of 10 $m/\sec^2$. Its apparent weight will be ($g = 10\ m/\sec^2$)

a) 1.0 $kgwt$ b) 2.0 $kgwt$ c) 0.5 kg/wt d) Zero

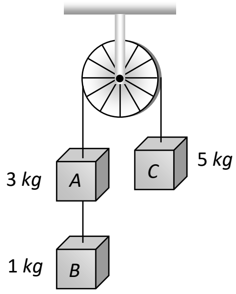
234. A man wants to slide down a rope. The breaking load for the rope $\frac{2}{3}$rd of the weight of the man. With what minimum acceleration should fireman slide down?

a) $\frac{g}{4}$ b) $\frac{g}{3}$ c) $\frac{2g}{3}$ d) $\frac{g}{6}$

235. Force required to move a mass of 1 kg at rest on a horizontal rough plane ($\mu = 0.1$ and $g = 9.8\ m/s^2$) is

a) 0.98 N b) 0.49 N c) 9.8 N d) 4.9 N

236. Three weight A, B and C are connected by string as shown in the figure. The system moves over a frictionless pulley. The tension in the string connecting A and B is (where g is acceleration due to gravity)



a) g b) $\frac{g}{9}$ c) $\frac{8g}{9}$ d) $\frac{10g}{9}$

237. For ordinary terrestrial experiments, the observer is an inertial frame in the following cases is

a) A child revolving in a giant wheel

b) A driver in a sports car moving with a constant high speed of 200 kmh^{-1} on a straight rod

c) The pilot of an aeroplane which is taking off

d) A cyclist negotiating a sharp curve

238. In a rocket of mass 1000 kg fuel is consumed at a rate of 40 kg/s. The velocity of the gases ejected from the rocket is $5 \times 10^4 m/s$. The thrust on the rocket is

a) $2 \times 10^3 N$ b) $5 \times 10^4 N$ c) $2 \times 10^6 N$ d) $2 \times 10^9 N$

239. A body is imparted motion from rest to move in a straight line. If it is then obstructed by an opposite force, then

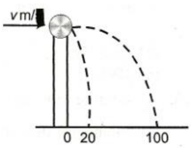
a) The body may necessarily change direction

b) The body is sure to slow down

c) The body will necessarily continue to move in the same direction at the same speed

d) None of these

240. A ball of mass 0.2 kg rests on a vertical post of height 5 m. A bullet of mass 0.01 kg, travelling with a velocity v m/s in a horizontal direction, hits the centre of the ball. After the collision, the ball and bullet travel independently. The ball hits the ground at a distance of 20 m and the bullet at ball hits the ground at a distance of 100 m from the foot of the post. The initial velocity v of the bullet is



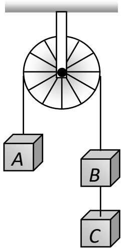
a) 250 m/s b) $250\sqrt{2}$m/s c) 400 m/s d) 500 m/s

241. A shell of mass 10 kg is moving with a velocity of 10 ms^{-1} when it blasts and forms two parts of mass

9 kg and 1 kg respectively. If the 1^{st} mass is stationary, the velocity of the 2^{nd} is

a) 1 m/s b) 10 m/s c) 100 m/s d) 1000 m/s

242. Three equal weights A, B and C of mass 2 kg each are hanging on a string passing over a fixed frictionless pulley as shown in the figure. The tension in the string connecting weights B and C is

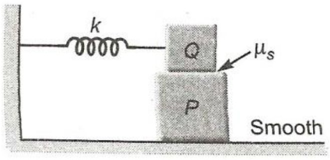


a) Zero b) 13 N c) 3.3 N d) 19.6 N

243. A force vector applied on a mass is represented as $\vec{F} = 6\hat{\imath} - 8\hat{\jmath} + 10\hat{k}$ and accelerates with 1 m/s^2. What will be the mass of the body

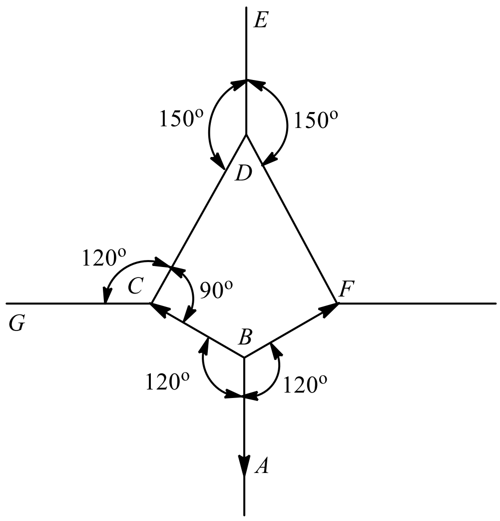
a) $10\sqrt{2}kg$ b) $2\sqrt{10}kg$ c) 10 kg d) 20 kg

244. A block P of mass m is placed on a horizontal surface. Another block Q of same mass is kept on P and connected to the wall with the help of a spring of spring constant k as shown in the figure. μ_s is the coefficient of friction between P and Q. The blocks move together performing SHM of amplitude A. The maximum value of the friction force between P and Q is



a) kA b) $\frac{kA}{2}$ c) Zero d) $\mu_s mg$

245. The adjacent figure is the part of a horizontally stretched net. Section AB is stretched with a force of 10 N. The tension in the section BC and BF are



a) 10 N, 11N b) 10 N, 6 N
c) 10 N, 10 N d) Can't be calculated due to insufficient data

246. A particle is moving with a constant speed along a straight line path. A force is not required to

a) Increase its speed b) Decrease the momentum
c) Change in direction d) Keep it moving with uniform velocity

247. A train is moving with velocity 20 m/s on this dust is falling at the rate 50kg/min. The extra force requested to move this train with a constant velocity will be

a) 16.66 N b) 1200 N c) 1000 N d) 166.6 N

248. A large force is acting on a body for a short time. The impulse imparted is equal to the change in

a) Acceleration b) Momentum c) Energy d) Velocity

249. A 1.5 kg ball drops vertically on a floor hitting with a speed of 25ms^{-1} . It rebounds with an initial speed of 15 ms^{-1}. If the ball was in contact for only 0.03 seconds, the force exerted on the floor by the ball is

a) 2000 N b) 3000 N c) 3500 N d) 4000 N

250. A bullet of mass 10 g moving with 300 m/s hits a block of ice of mass 5 kg and drops dead. The velocity of ice is

a) 50 cm/s b) 60 cm/s c) 40 cm/s d) 30 cm/s

251. Two masses of $M$and $4M$ are moving with equal kinetic energy. The ratio of their linear momentum is

a) 1:8 b) 1:4 c) 1:2 d) 4:1

252. A cold soft drink is kept on the balance. When the cap is open, then the weight

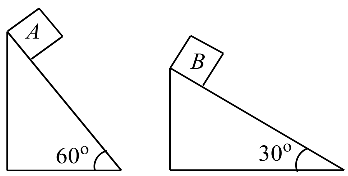
a) Increases

b) Decreases

c) First increases then decreases

d) Remains same

253. The fixed frictionless inclined planes making an angle 30° and 60° with the vertical are shown in the figure. Two blocks Aand B are placed on the two planes. What is the relative vertical acceleration of A with respect to B



a) 4.9 ms^{-2} in vertical direction

b) 4.9 ms^{-2} in horizontal direction

c) 9.8 ms^{-2} in vertical direction

d) Zero

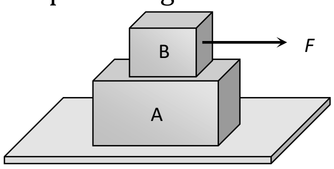
254. An object is kept on a smooth inclined plane of 1 in l. The horizontal acceleration to be imparted to the inclined plane so that the object is stationary relative to the inclined is

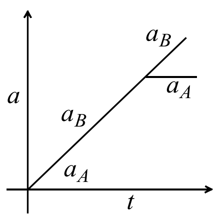
a) $g\sqrt{l^2-1}$ b) $g(l^2-1)$ c) $\dfrac{g}{\sqrt{l^2-1}}$ d) $\dfrac{g}{l^2-1}$

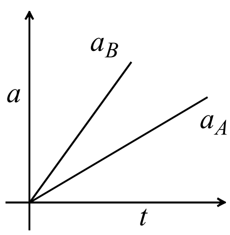
255. The minimum force required to start pushing a body up a rough (frictional coefficientμ) inclined plane is F_1 while the minimum force needed to prevent it from sliding down is F_2. If the inclined plane makes an angle θ from the horizontal such that $\tan\theta = 2\mu$, then the ratio $\frac{F_1}{F_2}$ is

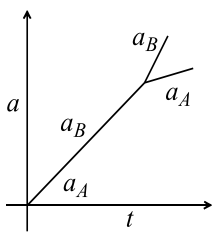
a) 4 b) 1 c) 2 d) 3

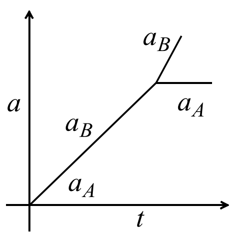
256. A block B is placed on block A. The mass of block Bis less that the mass of block A. Friction exists between the blocks, whereas the ground on which the block A is placed is taken to be smooth. A horizontal force F, increasing linearly with time begins to act on B. The acceleration a_A and a_B of blocks A and B respectively are plotted against t. The correctly plotted graph is



a) 

b) 

c) 

d) 

257. A body sitting on the topmost berth in the compartment of a train which is just going to stop on a railway station, drops an apple aiming at the open hand of his brother sitting vertically below his hands at a distance of about 2 m. The apple will fall

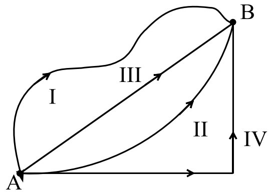
a) Precisely on the hand of his brother

b) Slightly away from the hand of his brother in the direction of motion of the train

c) Slightly away from the hand of his brother in the direction opposite to the direction of motion of the train

d) None of the above

258. In a gravitational force field a particle is taken from A to B along different paths as shown in figure. Then



a) Work done along path I will be maximum
b) Work done along path III will be minimum
c) Work done along path IV will be minimum
d) Work done along all the paths will be the same

259. When two surfaces are coated with a lubricant, then they
a) Stick to each other b) Slide upon each other c) Roll upon each other d) None of these

260. A plumb line is suspended from a ceiling of a car moving with horizontal acceleration of a. What will be the angle of inclination with vertical
a) $\tan^{-1}(a/g)$ b) $\tan^{-1}(g/a)$ c) $\cos^{-1}(a/g)$ d) $\cos^{-1}(g/a)$

261. A spring balance is attached to the ceiling of a lift. A man hangs his bag on the spring and the spring reads 49 N, when the lift is stationary. If the lift moves downward with an acceleration of 5 m/s^2, the reading of the spring balance will be
a) 49 N b) 24 N c) 74 N d) 15 N

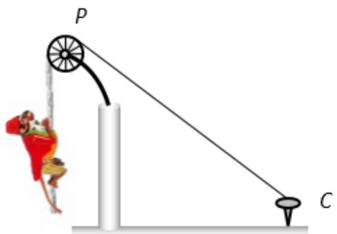
262. A block of mass 0.1 kg is held against a wall by applying a horizontal force of 5 N on the block. If the coefficient of friction between the block and the wall is 0.5, the magnitude of the frictional force acting on the block is
a) 2.5 N b) 0.98 N c) 4.9 N d) 0.49 N

263. A body of weight 64 N is pushed with just enough force to start it moving across a horizontal floor and the same force continues to act afterwards. If the coefficients of static and dynamic friction are 0.6 and 0.4 respectively, the acceleration of the body will be (Acceleration due to gravity $= g$)
a) $\frac{g}{6.4}$ b) 0.64 g c) $\frac{g}{32}$ d) 0.2 g

264. A lift accelerated downward with acceleration 'a'. A man in the lift throws a ball upward with acceleration $a_0 (a_0 < a)$. Then acceleration of ball observed by observer, which is on earth, is
a) $(a + a_0)$ upward b) $(a - a_0)$ upward c) $(a + a_0)$ downward d) $(a - a_0)$ downward

265. A lift is moving downwards with an acceleration equal to acceleration due to gravity. A body of mass m kept on the floor of the lift is pulled horizontally. If the coefficient of friction is μ, then the frictional resistance offered by the body is
a) mg b) μmg c) $2\mu mg$ d) Zero

266. One end of a massless rope, which passes over a massless and frictionless pulley P is tied to a hook C while the other end is free. Maximum tension that the rope can bear is 360 N. with what value of minimum safe acceleration (in ms^{-2}) can a monkey of 60 kg move down on the rope



a) 16 b) 6 c) 4 d) 8

267. Consider the following two statements :
I. Linear momentum of a system of particles is zero.
II. Kinetic energy of a system of particles is zero. Then
a) I does not imply II and II does not imply I
b) I implies II but II does not imply I
c) I does not imply II but II implies I
d) I implies II and II implies I

268. A rifle of 20 kg mass can fire 4 bullets per second. The mass of each bullet is 35×10^{-3} kg and its final

velocity 400 ms^{-1}. Then what force must be applied on the rifle so that it does not move backwards while firing the bullets?

a) 80 N b) 28 N c) −112 N d) −56 N

269. The momentum is most closely related to

a) Force b) Impulse c) Power d) K.E.

270. When a body is stationary

a) There is no force acting on it
b) The force acting on it is not in contact with it
c) The combination of forces acting on it balances each other
d) The body is in vacuum

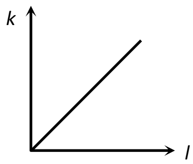
271. A block at rest slides down a smooth inclined plane which makes an angle 60° with the vertical and it reaches the ground in t_1 seconds. Another block is dropped vertically from the same point and reaches the ground in t_2 seconds.
Then the ratio of $t_1 : t_2$ is

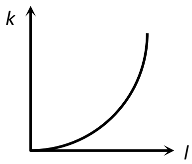
a) $1:2$ b) $2:1$ c) $1:3$ d) $1:\sqrt{2}$

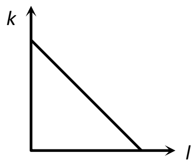
272. Which of the following is correct, when a person walks on a rough surface

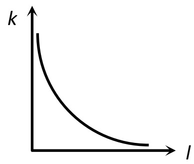
a) The frictional force exerted by the surface keeps him moving
b) The force which the man exerts on the floor keeps him moving
c) The reaction of the force which the man exerts on floor keeps him moving
d) None of the above

273. Which of the following graph depicts spring constant k versus length l of the spring correctly

a) 

b) 

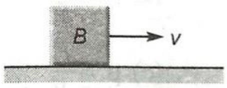
c) 

d) 

274. A block weighing W is held against a vertical wall by applying a horizontal force F. The minimum value of F needed to hold the block is

a) Less than W b) Equal to W c) Greater than W d) Data is insufficient

275. A block B is pushed momentarily along a horizontal surface with an initial velocity v. If μ is the coefficient of sliding friction between B and the surface, block B will come to rest after a time



a) $\frac{v}{g\mu}$ b) $\frac{g\mu}{v}$ c) $\frac{g}{v}$ d) $\frac{v}{g}$

276. An object placed on an inclined plane starts sliding when the angle of incline becomes 30°. The coefficient of static friction between the object and the plane is

a) $\frac{1}{\sqrt{3}}$ b) $\sqrt{3}$ c) $\frac{1}{2}$ d) $\frac{\sqrt{3}}{2}$

277. A spring balance is attached to the ceiling of a lift. A man hangs his bag on the spring and spring reads 49 N, when the lift is stationary. If the lift moves downward with an acceleration of 5 ms^{-2}, the reading of the spring balance will be

a) 24 N b) 74 N c) 15 N d) 49 N

278. A block of mass 50 kg can slide on a rough horizontal surface. The coefficient of friction between the block and the surface is 0.6. The least force of pull acting at an angle of 30° to the upward drawn vertical which causes the block to just slide is

a) 29.43 N b) 219.6 N c) 21.96 N d) 294.3 N

279. Two bodies of mass 3 kg and 4 kg are suspended at the ends of massless string passing over a frictionless pulley. The acceleration of the system is $(g = 9.8\ m/s^2)$

a) 4.9 m/s^2 b) 2.45 m/s^2 c) 1.4 m/s^2 d) 9.5 m/s^2

280. A body of mass 4 kg is accelerated upon by a constant force, travel a distance of 5 m in the first second and a distance of 2 m in the third second. The force acting on the body is

a) 2 N b) 4 N c) 6 N d) 8 N

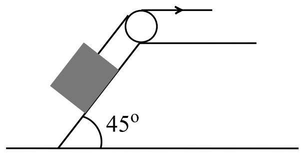
281. A block of mass 5 kg is moving horizontally at a speed of 1.5 m/s. A perpendicular force of 5N acts on it for 4 sec. What will be the distance of the block from the point where the force started acting

a) 10 m b) 8 m c) 6 m d) 2 m

282. If μ_s, μ_k and μ_r are coefficients of static friction, sliding friction and rolling friction, then

a) $\mu_s < \mu_k < \mu_r$ b) $\mu_k < \mu_r < \mu_s$ c) $\mu_r < \mu_k < \mu_s$ d) $\mu_r < \mu_k < \mu_s$

283. A block of mass 200 kg is being pulled up by men on an inclined plane at angle of 45° as shown. The coefficient of static friction is 0.5. Each man can only apply a maximum force of 500 N. Calculate the number of men required for the block to just start moving up the plane



a) 10 b) 15 c) 5 d) 3

284. A machine gun fires 20 bullets per second into a target. Each bullet weighs 150 gms and has a speed of 800 m/sec. Find the force necessary to hold the gun in position

a) 800 N b) 1000 N c) 1200 N d) 2400 N

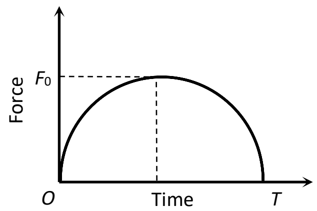
285. In relativity which is constant between two frames of reference

a) Acceleration b) Conservation of mass c) Space interval d) Velocity

286. If coefficient of friction between an inset and bowl is μ and radius of the bowl is r, the maximum height to which the insect can crawl in the bowl is

a) $r\left[1-\frac{1}{\sqrt{1+\mu^2}}\right]$ b) $\frac{r}{\sqrt{1+\mu^2}}$ c) $r\sqrt{1+\mu^2}$ d) $r[\sqrt{1+\mu^2}-1]$

287. A particle of mass m, initially at rest, is acted upon by a variable force F for a brief interval of time T. It begins to move with a velocity u after the force stops acting. F is shown in the graph as a function of time. The curve is semicircle



a) $u=\frac{\pi F_0^2}{2m}$ b) $u=\frac{\pi T^2}{8m}$ c) $u=\frac{\pi F_0 T}{4m}$ d) $u=\frac{F_0 T}{2m}$

288. Three solids of masses m_1, m_2 and m_3 are connected with weightless string in succession and are placed on a frictionless table. If the mass m_3 is dragged with a force T, the tension in the string between $m_2$andm_3 is

a) $\frac{m_2}{m_1+m_2+m_3}T$ b) $\frac{m_3}{m_1+m_2+m_3}T$ c) $\frac{m_1+m_2}{m_1+m_2+m_3}T$ d) $\frac{m_2+m_3}{m_1+m_2+m_3}T$

289. A block of mass 2 kg is at rest on a floor. The coefficient of static friction between block and the floor is 0.54. A horizontal force of 2.8 N is applied to the block. What should be the frictional force between the block and the floor? (Take $g = 10\ \mathrm{m/s^2}$)

a) 8.8 N b) 5.8 N c) 2.8 N d) 10.8 N

290. A block is gently placed on a conveyor belt moving horizontally with constant speed. After 4s the velocity of the block becomes equal to the velocity of belt. If the coefficient of friction between the block and the belt is 0.2, then velocity of the conveyor belt is

a) 2 $\mathrm{ms^{-1}}$ b) 4 $\mathrm{ms^{-1}}$ c) 6 $\mathrm{ms^{-1}}$ d) 8 $\mathrm{ms^{-1}}$

291. A 20 kg block is initially at rest on a rough horizontal surface. A horizontal force of 75 N is required set the block in motion. After it is in motion, a horizontal force of 60 N is required to keep the block moving with constant speed.The coefficient of static friction is

a) 0.38 b) 0.44 c) 0.52 d) 0.60

292. A book is lying on the table. What is the angle between the action of the book on the table and the reaction of the table on the book

a) 0° b) 30° c) 45° d) 180°

293. A body is moving along a rough horizontal surface with an initial velocity 6 m/s. If the body comes to rest after travelling $9m$, then the coefficient of sliding friction will be

a) 0.4 b) 0.2 c) 0.6 d) 0.8

294. Which activity is not based upon friction

a) Writing b) Speaking c) Hearing d) Walking

295. Starting from rest, the time taken by a body sliding down on a rough inclined plane at 45° with the horizontal is twice the time taken to travel on a smooth plane of same inclination and same distance. Then the coefficient of kinetic friction is

a) 0.25 b) 0.33 c) 0.50 d) 0.75

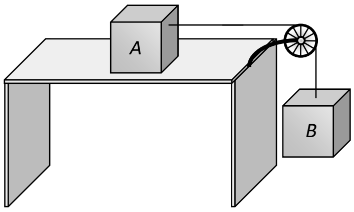
296. A body of mass $5kg$ rests on a rough horizontal surface of coefficient of friction 0.2. The body is pulled through a distance of $10m$ by a horizontal force of 25 N. The kinetic energy acquired by it is ($g = 10\ ms^2$)

a) 330 J b) 150 J c) 100 J d) 50 J

297. A force of 50 $dynes$ is acted on a body of mass 5 g which is at rest for an interval of 3 seconds, then impulse is

a) $0.15 \times 10^{-3} Ns$ b) $0.98 \times 10^{-3} Ns$ c) $1.5 \times 10^{-3} Ns$ d) $2.5 \times 10^{-3} Ns$

298. A block $A$of mass 7 kg is placed on a frictionless table. A thread tied to it passes over a frictionless pulley and carries a body B of mass 3 kg at the other end. The acceleration of the system is (given $g = 10\ ms^{-2}$)

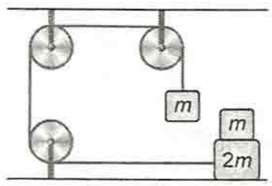


a) 100 ms^{-2} b) 3 ms^{-2} c) 10 ms^{-2} d) 30 ms^{-2}

299. A conveyor belt is moving at a constant speed of 2 m/s. A box is gently dropped on it. The coefficient of friction between them is $\mu = 0.5$. The distance that the box will move relative to belt before coming to rest on it, taking $g = 10\ ms^{-2}$, is

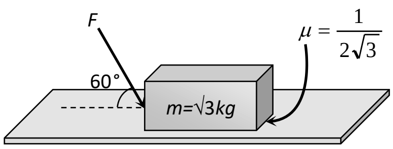
a) Zero b) 0.4 m c) 1.2 m d) 0.6 m

300. Mass of 3 kg descending vertically downward supports a mass of 2 kg by means the end of 5 s, the string breaks. How much higher the 2 kg mass will go further?



a) 4.9 m b) 9.8 m c) 19.6 m d) 2.45 m

301. What is the maximum value of the force F such that the block shown in the arrangement, does not move

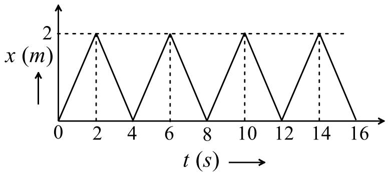


a) 20 N b) 10 N c) 12 N d) 15 N

302. Newton's Second law gives the measure of

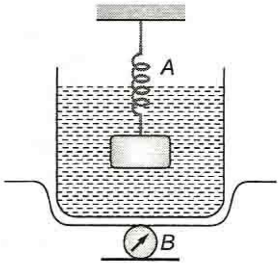
a) Acceleration b) Force c) Momentum d) Angular momentum

303. The figure shows the position – time ($x - t$) graph of one-dimensional motion of a body of mass 0.4 kg. The magnitude of each impulse is



a) $0.2\ Ns$ b) $0.4\ Ns$ c) $0.8\ Ns$ d) $1.6\ Ns$

304. A spring balance, A reads 2 kg with a block m suspended from it. A balance B reads 5 kg when a breaker filled with liquid is put on the pan of the balance. The two balances are now so arranged that the hanging mass is inside the liquid as shown in figure. In this situation

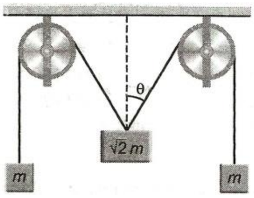


a) The balance A will read more than 2 kg
b) The balance B will read more than 5 kg
c) The balance A will read less than 2 kg and B will read more than 5 kg
d) The balance A and B will read 2 kg and 5 kg

305. A satellite in force-free space sweeps stationary interplanetary dust at a rate $dM/dt = \alpha v$ where M is the mass, v is the velocity of the satellite and α is a constant. What is the deacceleration of the satellite

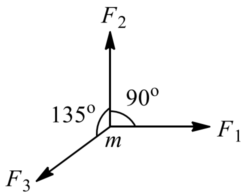
a) $-2\alpha v^2/M$ b) $-\alpha v^2/M$ c) $+\alpha v^2/M$ d) $-\alpha v^2$

306. The pulley and strings shown in the figure are smooth and of negligible mass. For the system to remain in equilibrium, the angle θ should be



a) 0° b) 30° c) 45° d) 60°

307. When a force F acts on a body of mass m, the acceleration produced in the body is a. If three equal forces $F_1 = F_2 = F_3 = F$ act on the same body as shown in figure, the acceleration produced is



a) $(\sqrt{2}-1)a$ b) $(\sqrt{2}+1)a$ c) $\sqrt{2}a$ d) a

308. Physical independence of force is consequence of

a) Third law of motion b) Second law of motion c) First law of motion d) All of the above

309. A man is standing at a spring platform. Reading of spring balance is 60 $kgwt$. If man jumps outside platform, then reading of spring balance

a) First increases then decreases to zero b) Decreases
c) Increases d) Remains same

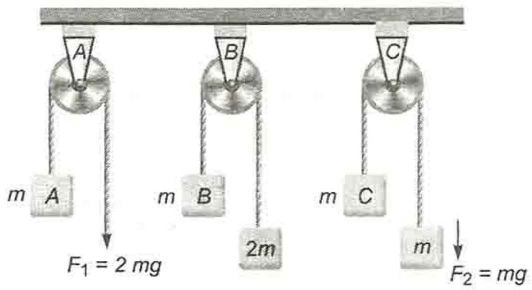
310. Two forces of magnitude F have a resultant of the same magnitude F. The angle between the two forces is

a) 45° b) 120° c) 150° d) 60°

311. An explosion blows a rock into three parts. Two parts go off at right angles to each other. These two are, 1 kg first part moving with a velocity of 12 ms^{-1} and 2 kg second part moving with a velocity of 8 ms^{-1}. If the third part files off with a velocity of 4 ms^{-1}, its mass would be

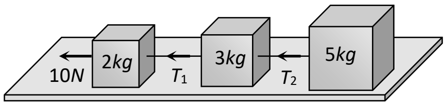
a) 5 kg b) 7 kg c) 17 kg d) 3 kg

312. An elevator and its load have a total mass of 800 kg. The elevator is originally moving downwards at $10\ \mathrm{ms}^{-1}$, it slows down to stop with constant acceleration in a distance of 25 m. Find the tension T in the supporting cable while the elevator is being brought to rest. (Take $\mathrm{g} = 10\ \mathrm{ms}^{-2}$)
a) 8000 N b) 1600 N c) 9600 N d) 6400 N
313. A boy B lies on a smooth horizontal table and another body $A$is placed on B. The coefficient of friction between A and B is μ. What acceleration given to B will cause slipping to occur between A and B
a) μg b) g/μ c) μ/g d) $\sqrt{\mu g}$
314. A mass of 10 kg is suspended from a string balance. It is pulled aside by a horizontal string so that it makes an angle of 60° with the vertical. The new reading of the balance is
a) 20 kg-wt b) 10 kg-wt c) $10\sqrt{3}$ kg-wt d) $20\sqrt{3}$ kg-wt
315. A nucleus disintegrates into two nuclear parts which have their velocities in the ratio 2 ∶ 1. The ratio of their nuclear sizes will be
a) $2^{1/3}: 1$ b) $1: 3^{1/2}$ c) $3^{1/2}: 1$ d) $1: 2^{1/3}$
316. A block of mass 1 kg is at rest on a horizontal table. The coefficient of static friction between the block and the table is 0.5. If $\mathrm{g} = 10\mathrm{ms}^{-2}$, then the magnitude of the force acting upwards at an angle of 60° from the horizontal that will just start the block moving is
a) 5 N b) 5.36 N c) 74.6 N d) 10 N
317. The backside of a truck is open and a box of 40 kg is placed 5 m away from the rear end. The coefficient of friction of the box with the surface of the truck is 0.15. The truck starts from rest with $2\ \mathrm{m/s^2}$ acceleration. Calculate the distance covered by the truck when the box falls off.
a) 20 m b) 30 m c) 40 m d) 50 m
318. A block compartment containing gas is moving with some acceleration in horizontal direction. Neglect effect of gravity. Then the pressure in the compartment is
a) Same everywhere b) Lower in front side c) Lower in rear side d) Lower in upper side
319. A boy of mass 0.25 kg is projected with muzzle velocity 100 ms^{-1} from a tank of mass 100 kg. What is the recoil velocity of the tank
a) 5 ms^{-1} b) 25 ms^{-1} c) 0.5 ms^{-1} d) 0.25 ms^{-1}
320. A rocket with a lift-off mass $3.5 \times 10^4 kg$ is blasted upwards with an initial acceleration of 10 m/s^2. Then the initial thrust of the blast is
a) $1.75 \times 10^5 N$ b) $3.5 \times 10^5 N$ c) $7.0 \times 10^5 N$ d) $14.0 \times 10^5 N$
321. A stationary body of mass 3 kg explodes into three equal pieces. Two of the pieces fly off in two mutually perpendicular directions, one with a velocity of $3\hat{\imath} ms^{-1}$ and the other with a velocity of $4\hat{\jmath} ms^{-1}$. If the explosion occurs in $10^{-4} s$, the average force acting on the third piece in newton is
a) $(3\hat{\imath} + 4\hat{\jmath}) \times 10^{-4}$ b) $(3\hat{\imath} - 4\hat{\jmath}) \times 10^{-4}$ c) $(3\hat{\imath} + 4\hat{\jmath}) \times 10^{4}$ d) $-(3\hat{\imath} + 4\hat{\jmath}) \times 10^{4}$
322. Newton's third law of motion leads to the law of conservation of
a) Angular momentum b) Energy c) Mass d) Momentum
323. A block of mass m is placed on a smooth wedge of inclination θ. The whole system is accelerated horizontally so that the block does not slip on the wedge. The force exerted by the wedge on the block (g is acceleration due to gravity) will be
a) $mg \cos\theta$ b) $mg \sin\theta$ c) mg d) $mg/\cos\theta$
324. In figure, the blocks A, B and C each of mass m have acceleration a_1, a_2 and a_3 respectively. F_1 and F_2 are external forces of magnitude 2 mg and mg respectively.
Then



a) $a_1 = a_2 = a_3$ b) $a_1 > a_3 > a_2$ c) $a_1 = a_2, a_2 = a_3$ d) $a_1 = a_2, a_1 = a_3$

325. Three blocks of masses 2 kg, 3 $kg$and 5 $kg$are connected to each other with light string and are then placed on a frictionless surface as shown in the figure. The system is pulled by a force $F = 10\ N$, then tension $T_1 =$



a) 1 N b) 5 N c) 8 N d) 10 N

326. A rope of length L is pulled by a constant force F. What is the tension in the rope at a distance x from the end where the force is applied

a) $\frac{FL}{x}$ b) $\frac{F(L-x)}{L}$ c) $\frac{FL}{L-x}$ d) $\frac{Fx}{L-x}$

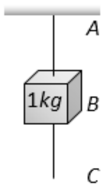
327. An 80 kg person is parachuting and is experiencing a downward acceleration of 2.8ms^{-2}. The mass of the parachute is 5 kg. The upward force on the open parachute is (Take $g = 9.8\text{ms}^{-2}$)

a) 595 N b) 675 N c) 456 N d) 925 N

328. Two persons are holding a rope of negligible weight tightly at its ends so that it is horizontal. A 15 kg weight is attached to rope at the mid-point which now no more remains horizontal. The minimum tension required to completely straighten the rope is

a) 15 kg b) 15/2 kg c) 5 kg d) Infinitely large

329. A mass of 1 kg is suspended by a string A. Another string C is connected to its lower end (see figure). If a sudden jerk is given to C, then

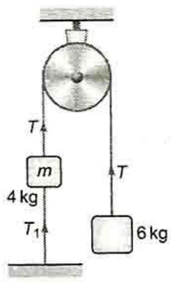


a) The portion AB of the string will break b) The portion BC of the string will break
c) None of the strings will break d) The mass will start rotating

330. If force on a rocket having exhaust velocity of 300 m/sec is 2010 N, then rate of combustion of the fuel is

a) 0.7 kg/s b) 1.4 kg/s c) 0.07 kg/s d) 10.7 kg/s

331. Two bodies of mass 4 kg and 6 kg are attached to the ends of a string passing over a pulley. The 4 kg mass is attached to the table by another string. The tension in this string T_1 is



a) 19.6 N b) 25 N c) 10.6 N d) 10 N

332. The time in which a force of 2 N produces a change in momentum of 0.4 $kg - ms^{-1}$ in the body is

a) 0.2 s b) 0.02 s c) 0.5 s d) 0.05 s

333. A marble block of mass 2 kglying on ice when given a velocity of 6 m/s is stopped by friction in 10s. Then

the coefficient of friction is

a) 0.01 b) 0.02 c) 0.03 d) 0.06

334. A gardner waters the plants by a pipe of diameter 1mm. The water comes out at the rate or 10 cm^3/sec. The reactionary force exerted on the hand of the gardner is

a) Zero b) $1.27 \times 10^{-2} N$ c) $1.27 \times 10^{-4} N$ d) $0.127\ N$

335. If a bullet of mass 5 gm moving with velocity 100 m/sec, penetrates the wooden block upto 6 cm. Then the average force imposed by the bullet on the block is

a) 8300 N b) 417 N c) 830 N d) Zero

336. A block of mass M is attached to the lower end of a vertical rope of mass. An upward force P acts on the upper end of the rope. The system is free to move. The force exerted by the rope on the block is $\frac{PM}{M+m}$

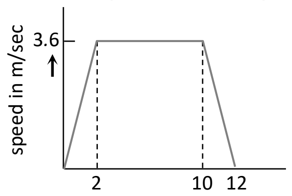
a) In all cases b) Only if the rope is uniform

c) In gravity-free space only d) Only if $P > (M+m)g$

337. A force of 750 N is applied to a block of mass 102 kg to prevent it from sliding on a plane with an inclination angle 30° with the horizontal. If the coefficients of static friction and kinetic friction between the block and the plane are 0.4 and 0.3 respectively, then the frictional force acting on the block is

a) 750 N b) 500 N c) 345 N d) 250 N

338. A lift is going up. The total mass of the lift and the passenger is 1500 kg the variation in the speed of the lift is as given in the graph. The tension in the rope pulling the lift at $t = 11^{\text{th}} sec$ will be



a) 17400 N b) 14700 N c) 12000 N d) Zero

339. The upper half of an inclined plane of inclination θ is perfectly smooth while the lower half is rough. A body starting from the rest at top comes back to rest at the bottom if the coefficient of friction for the lower half is given by

a) $\mu = \sin\theta$ b) $\mu = \cot\theta$ c) $\mu = 2\cos\theta$ d) $\mu = 2\tan\theta$

340. A passenger train is running on a railways track with a speed v_1. While driving, the driver discovers that another goods train is travelling in front of the passenger train with a speed $v_2 (v_1 > v_2)$. Its retardation after applying brakes is a. The least distance the passenger train must travel to avoid collision with goods train is

a) $\frac{v_1^2 - v_2^2}{2a}$ b) $\frac{v_2 - v_1}{a}$ c) $\frac{v_2 + v_1}{2a}$ d) $\frac{v_2^2 + v_1^2}{2a}$

341. In the above ques., the height to which the lift takes the passenger is

a) 3.6 $meters$ b) 8 $meters$ c) 1.8 $meters$ d) 36 $meters$

342. When forces F_1, F_2, F_3 are acting on a particle of mass m such that F_2 and F_3 are naturally perpendicular, then the particle remains stationary. If the force F_1 is now removed then the acceleration of the particle is

a) F_1/m b) F_2F_3/mF_1 c) $(F_2 - F_3)/m$ d) F_2/m

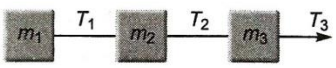
343. A force of 5 N acts on a body of weight 9.8 N. What is the acceleration produced in $m/\sec^2$

a) 49.00 b) 5.00 c) 1.46 d) 0.51

344. Two small balls of same size and masses m_1 and $m_2 (m_1 > m_2)$ are tied by a thin weightless thread and dropped from a certain height. Training upward buoyancy force F into account, the tension T of the thread during the flight after the motion of the ball becomes uniform will be

a) $(m_1 - m_2)g$ b) $(m_1 - m_2)g/2$ c) $(m_1 + m_2)g$ d) $(m_1 + m_2)g/2$

345.



In the figure shown, $m_1 = 10$ kg, $m_2 = 6$ kg, $m_3 = 4$ kg. If $T_3 = 40$ N, $T_2 = ?$

a) 13 N b) 32 N c) 25 N d) 35 N

346. A body of mass 2 kg is kept by pressing to a vertical wall by a force of 100 N. The coefficient of friction between wall and body is 0.3. Then the frictional force is equal to

a) 6 N b) 20 N c) 600 N d) 700 N

347. The upper half of an inclined plane with inclination ϕ is perfectly smooth, while the lower half is rough. A body starting from rest at the top will again come to rest at the bottom if coefficient of friction for the lower half is given by

a) $2 \sin \phi$ b) $2 \cos \phi$ c) $2 \tan \phi$ d) $\tan \phi$

348. A diwali rocket is ejecting 0.05 kg of gases per second at a velocity of 400 m/sec. The accelerating force on the rocket is

a) 20 $dynes$ b) 20 N c) 22 $dynes$ d) 1000 N

349. When a bullet is fired at a target, its velocity decreases by half after penetrating 30 cm into it. The additional thickness it will penetrate before coming to rest is

a) 30 cm b) 40 cm c) 10 cm d) 50 cm

350. The normal reaction on a body placed in a lift moving up with constant acceleration 2 ms^{-1} is 120 N. Mass of body is (Take $\text{g} = 10\ \text{ms}^{-2}$)

a) 10 kg b) 15 kg c) 12 kg d) 5 kg

351. In the above Question, if the string C is stretched slowly, then

a) The portion AB of the string will break
b) The portion BC of the string will break
c) None of the strings will break
d) None of the above

352. A block of mass M placed on a frictionless horizontal table is pulled by another block of mass m hanging vertically by a massless string passing over a frictionless pully. The tension in the string is

a) $\dfrac{m}{M+m}g$ b) $\dfrac{M}{M+m}g$ c) $\dfrac{M+m}{Mm}g$ d) $\dfrac{Mm}{M+m}g$

353. Rocket propulsion is associated with

a) The conservation of angular momentum
b) The conservation of mass
c) The conservation of mechanical energy
d) Newton's III law of motion

354. A cricket ball of mass 250 g collides with a bat with velocity 10 m/s and returns with the same velocity within 0.01 second . The force acted on bat is

a) 25 N b) 50 N c) 250 N d) 500 N

355. A bullet is fired from a gun. The force on the bullet is given by $F = 600 - 2 \times 10^5 t$, where F is in $newtons$ and t in seconds. The force on the bullet becomes zero as soon as it leaves the barrel. What is the average impulse imparted to the bullet

a) 9 Ns b) Zero c) 0.9 Ns d) 1.8 Ns

356. A machine gun fires n bullets per second, each of mass m. If the speed of each bullet is u, then the force of recoil is

a) mng b) mnv c) $mnvg$ d) $\dfrac{mnv}{\text{g}}$

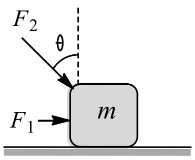
357. A person is measuring his weight by standing on a weighing machine inside a lift. When the lift is at rest, the machine shows his weight to be 55 kg. In between the floor when the lift is moving up with a constant speed of 10 km/hr, he again measures his weight, which is

a) 55 kg b) 65 kg c) 50 kg d) 45 kg

358. A lift is moving upwards with a uniform velocity v in which a block of mass m is lying. The frictional force offered by the block, when coefficient of the frictional is μ, will be

a) Zero b) mg c) μmg d) $2\mu mg$

359. A block of mass m on a rough horizontal surface is acted upon by two forces as shown in figure. For equilibrium of block, the coefficient of friction between block and surface is



a) $\dfrac{F_1 + F_2 \sin\theta}{mg + F_2 \cos\theta}$ b) $\dfrac{F_1 \sin\theta + F_2}{mg + F_2 \sin\theta}$ c) $\dfrac{F_1 + F_2 \cos\theta}{mg + F_2 \sin\theta}$ d) $\dfrac{F_1 \sin\theta - F_2}{mg - F_2 \cos\theta}$

360. A rope of length L is pulled by a constant force F. What is the tension in the rope at distance x from the end

when the force is applied?

a) $\frac{F(L-x)}{L}$ b) $\frac{FL}{L-x}$ c) $\frac{FL}{x}$ d) $\frac{Fx}{L-x}$

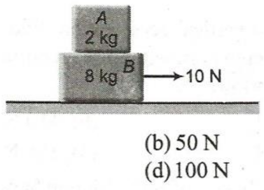
361. The mass of a body measured by a physical balance in a lift at rest is found to be m. If the lift is going up with an acceleration a, its mass will be measured as

a) $m\left(1-\frac{a}{g}\right)$ b) $m\left(1+\frac{a}{g}\right)$ c) m d) Zero

362. If a body of mass m is moving on a rough horizontal surface of coefficient of kinetic friction μ, the net electromagnetic force exerted by surface on the body is

a) $mg\sqrt{1+\mu^2}$ b) μmg c) mg d) $mg\sqrt{1-\mu^2}$

363. Block A of mass 2 kg is placed over block B of mass 8 kg. The combination is placed over a rough horizontal surface. Coefficient of friction between B and the floor is 0.5. Coefficient of friction between A and B is 0.4. A horizontal force of 10 N is applied on block$B$. The force of friction between A and B is



a) Zero b) 50 N c) 40 N d) 100 N

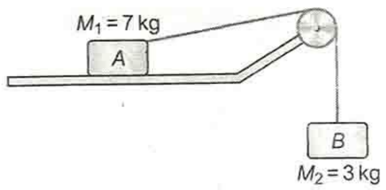
364. Consider a car moving along a straight horizontal road with a speed of 72 km/h. If the coefficient kinetic friction between the tyres and the road is 0.5, the shortest distance in which the car can be stopped is [$g = 10\ ms^{-2}$]

a) 30 m b) 40 m c) 72 m d) 20 m

365. A ball of mass 0.2 kg is thrown vertically upwards by applying a force by hand. If the hand moves 0.2 m while applying the force and the ball goes upto 2 m height further, find the magnitude of the force. Consider $g = 10\ m/s^2$

a) 16 N b) 20 N c) 22 N d) 4 N

366. A block A of mass 7 kg is placed on a frictionless table. A thread tied to it passes over a frictionless pulley and carries a body B of mass 3 kg at the other end, as in figure. The acceleration of the system is (given $g = 10\ ms^{-2}$)



a) 100 ms^{-2} b) 3 ms^{-2} c) 10 ms^{-2} d) 30 ms^{-2}

367. Three weights W, $2W$ and $3W$ are connected to identical springs suspended from a rigid horizontal rod. The assembly of the rod and the weights fall freely. The positions of the weights from the rod are such that

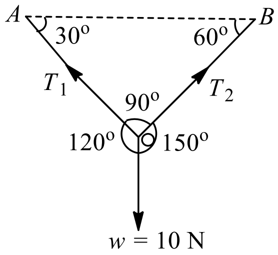
a) $3W$ will be farthest b) W will be farthest

c) All will be at the same distance d) $2W$ will be farthest

368. A ball of mass m moves with speed v and it strikes normally with a wall and reflected back normally, if its time of contact with wall is$t$ then find force exerted by ball on wall

a) $\frac{2mv}{t}$ b) $\frac{mv}{l}$ c) mvt d) $\frac{mv}{2t}$

369. A ball of mass 1 kg hangs in equilibrium from two strings OA and OB as shown in figure. What are the tensions in strings OA and OB? (Take $g = 10\ ms^{-2}$)



a) 5 N, zero b) Zero, N c) 5 N, $5\sqrt{3}$ N d) $5\sqrt{3}$ N, 5 N

370. Same force acts on two bodies of different masses 3 kg and 5 kg initially at rest. The ratio of times required to acquire same final velocity is

a) 5: 3 b) 25: 9 c) 9: 25 d) 3: 5

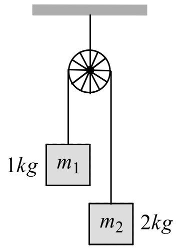
371. A body of mass 40 kg resting on a rough horizontal surface is subjected to a force P which is just enough to start the motion of the body. If $\mu_s = 0.5, \mu_k = 0.4, \mathrm{g} = 10\ \mathrm{ms}^{-2}$ and the force P is continuously applied on the body, then the acceleration of the body is

a) Zero b) 1 ms^{-2} c) 2 ms^{-2} d) 2.4 ms^{-2}

372. In an air collision between an aeroplane and a bird, the force experienced by the bird as compared to that of the aeroplane is

a) Very high b) Equal c) Less d) Zero

373. Two masses $m_1 = 1\ kg$ and $m_2 = 2kg$ are connected by a light inextensible string and suspended by means of a weightless pulley as shown in the figure. Assuming that both the masses start from rest, the distance travelled by the centre of mass in two seconds is (Take $g = 10ms^{-2}$)



a) $\frac{20}{9}m$ b) $\frac{40}{9}m$ c) $\frac{2}{3}m$ d) $\frac{1}{3}m$

1 **(c)**

$F = \frac{dp}{dt}$, so the force is maximum when slope of graph is maximum

2 **(b)**

The maximum tension $= 30 \times 10\, N = 300\, N$

$T - mg = ma$

$300 - 10 \times 10 = 10a$

$\Rightarrow a = 20\, m/s^2$ [Maximum value]

When the mass is raised, $u = 0, a = 20\, m/s^2$

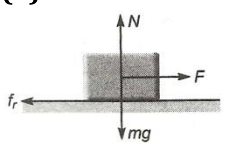
$S = 10m, t = ?$

$10 = \frac{1}{2} \times 20. t^2 \Rightarrow t = 1s$

4 **(c)**

According to principle of conservation of linear momentum $1000 \times 50 = 1250 \times v \Rightarrow v = 40\, km/hr$

5 **(a)**



Given that, $\mu = 0.1$ and $g = 9.8\ \text{ms}^{-2}$

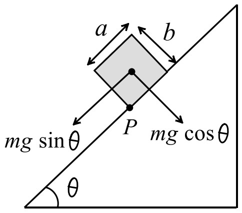
So, $F = f_r = \mu N = \mu\, mg$

$= 0.1 \times 1 \times 9.8 = 0.98$ N

6 **(b)**

For rotational equilibrium about point "P",

$mg \sin\theta \left(\frac{b}{2}\right) = mg \cos\theta \left(\frac{a}{2}\right)$



$\Rightarrow \tan\theta = \frac{a}{b} = \frac{10}{15} = \frac{2}{3}$

$\Rightarrow \theta = 33.69°$

$i.e.$, toppling starts at $\theta = 33.69°$

and angle of repose $= \tan^{-1}(\mu) = \tan^{-1}(\sqrt{3}) = 60°$

It mean the block will remain at rest on the plane up to certain angle θ and then it will topple

7 **(d)**

Force$\mathbf{F} = \frac{\mathbf{dp}}{dt} = -kA\sin(kt)\hat{\mathbf{i}} - kA\cos(kt)\hat{\mathbf{j}}$

$\mathbf{p} = A\cos(kt)\hat{\mathbf{i}} - A\sin(kt)\hat{\mathbf{j}}$

Since, $\mathbf{F} \cdot \mathbf{p} = 0$

$\therefore$ Angle between $\mathbf{F}$ and $\mathbf{p}$ should be $90°$

8 **(c)**

Newton's first law of motion defines the inertia of body. It states that every body has a tendency to remain in its state (either rest or motion) due to its inertia

9 **(b)**

$$F = \frac{udm}{dt} = m(g + a)$$

$$\Rightarrow \frac{dm}{dt} = \frac{m(g+a)}{u} = \frac{5000 \times (10 + 20)}{800}$$

$$= 187.5\, kg/s$$

10 **(b)**

Net force on mass $m, ma = F - T\ \therefore a = \frac{F-T}{m}$

11 **(a)**

For a smooth plane, $v = \sqrt{2g\sin\theta . s}$ and for a rough plane,

$\frac{v}{n} = \sqrt{2g(\sin\theta - \mu\cos\theta)\, .\, s}$

$\therefore\ n = \sqrt{\frac{\sin\theta}{\sin\theta - \mu\cos\theta}}$ or $n^2 = \frac{\sin\theta}{\sin\theta - \mu\cos\theta}$

$\Rightarrow\ (n^2 - 1)\sin\theta = n^2\mu\cos\theta$

or $\mu = \left(\frac{n^2-1}{n^2}\right)\tan\theta = \tan\theta\left(1 - \frac{1}{n^2}\right)$

12 **(a)**

In Case of projectile motion at the highest point $(v)_{\text{vertical}} = 0$ and $(v)_{\text{horizontal}} = v\cos\theta$

The initial linear momentum of the system will be $mv\cos\theta$. Now as force of blasting is internal and force of gravity is vertical

So linear momentum of the system along horizontal is conserved

$p_1 + p_2 = mv\cos\theta$

$m_1v_1 + m_2v_2 = mv\cos\theta$

But it is given that $m_1 = m_2 = \frac{m}{2}$ and as one part retraces its path,

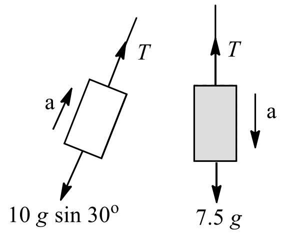
$v_1 = -v\cos\theta$

$\therefore \frac{1}{2}m(-v\cos\theta) + \frac{1}{2}mv^2 = mv\cos\theta$

or $v_2 = 3v\cos\theta$

13 **(d)**

Refer to the free-body diagrams



$T - 10g\sin 30° = 10a$ or $T - 5g = 10a$

Again , $7.5 - T = 7.5\alpha$

Adding, $2.5\mathrm{g} = 17.5\alpha$

or $\alpha = \frac{25\mathrm{g}}{175} = \frac{\mathrm{g}}{7}$

14 **(c)**

Apparent weight of the man, $R = m(g + a)$

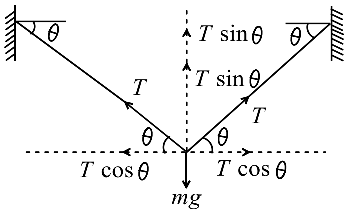
$= m(g + 4g) = 5mg$

15 **(b)**

Since, force needed to overcome frictional force

17 **(c)**

Mass of rope, $m = 0.1\ kg, \theta = 10°$



From figure, $2T\sin\theta = mg$

$\Rightarrow T = \dfrac{mg}{2\sin\theta} = \dfrac{0.1 \times 9.8}{2\sin 10°} = 2.82\ N$

18 **(c)**

$T = m(g + a) = 1000(9.8 + 1) = 10800\ N$

19 **(c)**

Effective upward force $= 310 - mg$

$= 310 - 24 \times 9.8 = 74.8$ N

Upward acceleration

$\therefore a = 74.8/24 = 3.12\ \mathrm{ms}^{-2}$

As $s = ut + \frac{1}{2}at^2$

$4.6 = 0 + \frac{1}{2} \times 3.12 \times t^2$

or $t^2 = \frac{4.6}{1.56} = 2.95$

or $t = \sqrt{2.95} = 1.7\mathrm{s}$

20 **(a)**

In case of upward motion

$F = m(g + a)$

$= 60(9.8 + 4.9)$

$= 60(14.7)$

$= 882$ kg

21 **(d)**

Impulse = Change in momentum

$F \times t = m(v - u)$

$F \times 0.4 = 80(5 - 0) \Rightarrow F = \frac{80\times5}{0.4} = 1000\mathrm{N}$

22 **(b)**

From the relation, acceleration

$a = \dfrac{F}{m_1 + m_2 + m_3} \Rightarrow a = \dfrac{40}{10 + 6 + 4} = 2\mathrm{ms}^{-2}$

$\therefore 40 - T = 10 \times 2$

$T = 20$ N

23 **(b)**

From Newton's second law

$F = n \cdot \left(\dfrac{\Delta p}{\Delta t}\right)$

Here, F = Force, n = number of bullets fired per second.

$\dfrac{\Delta p}{\Delta t}$ = rate of change of momentum of one bullet.

$\Rightarrow F = n\left[\dfrac{mv - 0}{\Delta t}\right]$

$\Rightarrow F = n \times \dfrac{mv}{\Delta t}$

Hence, $F = 144$ N, $m = 40\mathrm{g} = 40 \times 10^3\mathrm{kg}$

and $v = 1200\ \mathrm{ms}^{-1}, \Delta t = 1$ s.

$\therefore 144 = n \times \dfrac{40 \times 10^{-3} \times 1200}{1}$

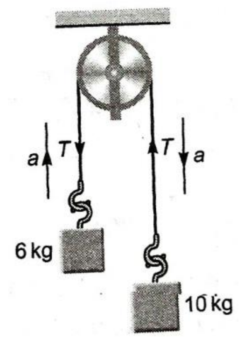
$or n = \dfrac{144}{4 \times 12} \Rightarrow n = 3$

24 **(a)**

Equation for the given system

$10\ g - T = 10a$ ...(i)

$T - 6g = 6a$ ....(ii)



From Eqs. (i) and (ii)

$T = 75$ N

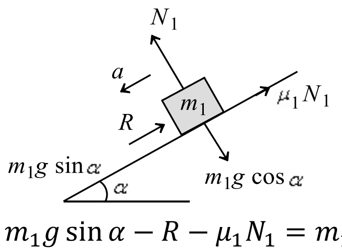
25 **(b)**

$T_1 = 0.25 \times 100$ N

or $T_1 = 25$ N

26 **(b)**

Let contact force $= R$



$m_1 g\sin\alpha - R - \mu_1 N_1 = m_1 a$ ...(i)

$R = \dfrac{(\mu_2 - \mu_1)m_1 m_2 g\cos\alpha}{(m_1 + m_2)}$

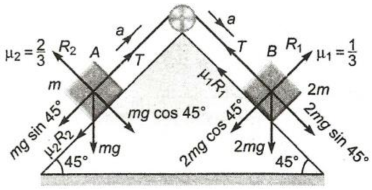
$\Rightarrow R = \dfrac{0.1\times8\times9.8\times\sqrt{\frac{3}{2}}}{6}$ ...(ii)

On simplify equation (i) and (ii),

$a = 2.646\ m/s^2$

27 **(d)**

The situation is as shown in the figure



The equation of motion for body B.

$2mg\sin 45° - \mu_1 R_1 - T_1 - T_2 = 2ma$

$2mg\sin 45° - \frac{1}{3}2mg\cos 45° - T = 2ma$

$\Longrightarrow \quad 2mg\times\frac{1}{\sqrt{2}} - \frac{1}{3}2mg\times\frac{1}{\sqrt{2}} - T = 2ma \quad \ldots.(\text{i})$

In the problem as $(m_B - m_A)g\cos\theta = (mg/\sqrt{2})$ is lesser than

$(\mu_B m_B + \mu_A m_A)g\cos\theta = (4mg/3\sqrt{2})$ the masses will not move and hence.

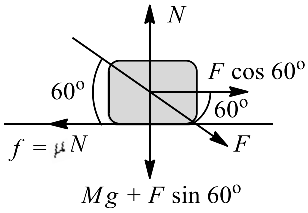
Acceleration of $B =$ acceleration of $A = 0$.

28 **(a)**

From acting on block are shown in adjoining figure

As the block does not move, hence

$F\cos 60° = f = \mu N = \mu(Mg + F\sin 60°)$



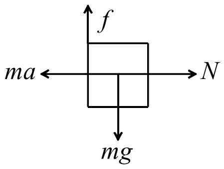
$\therefore F\frac{1}{2} = \frac{1}{2\sqrt{3}}\left(\sqrt{3}\times 10 + F\cdot\frac{\sqrt{3}}{2}\right)$

On simplification, we get $F = 20$ N

29 **(d)**

$T = mg = 50\times 10^{-3}\times 10 = 0.5\ N$

30 **(d)**



Here $f = mg$ and $N = m\alpha$ but $f \le \mu N$

So $mg \le \mu m\alpha \Rightarrow \alpha \ge \frac{g}{\mu}$

31 **(b)**

Combined momentum $= 2p\hat{\mathbf{i}} + p\hat{\mathbf{j}}$

Magnitude of combined momentum

$= \sqrt{(2p)^2 + p^2} = \sqrt{5p^2} = \sqrt{5}p$

This must be equal to the momentum of the third part

32 **(c)**

$W = \mu mg\cos\theta\, S = 0.5\times 1\times 9.8\times\frac{1}{2}\times 1 = 2.45\ J$

33 **(b)**

Thrust force by rocket

$F_t = v_r\left(-\frac{dm}{dt}\right)$(upwards)

Weight of the rocket

$w = mg$(downwards)

Net force on the rocket

$F_{\text{net}} = f_t - w$

$\Longrightarrow ma = v_r\left(\frac{-dm}{dt}\right) - mg$

$\Longrightarrow ma = v_r\left(\frac{-dm}{dt}\right) = \frac{m(g+a)}{v_r}$

$\therefore$ Rate of the ejected per second

$= \frac{5000(10+20)}{800} = \frac{5000\times 30}{800}$

$= 187.5\ \text{kgs}^{-1}$

34 **(d)**

Given that, $\frac{dm}{dt} = 0.1\ \text{kgs}^{-1}$;

mass of the rocket=100 kg

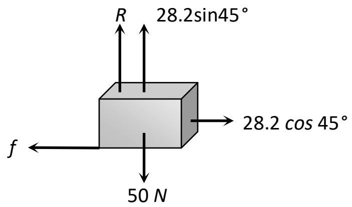
and $v = 1\ \text{kms}^{-1} = 1000\ \text{ms}^{-1}$

Thrust on the rocket, $F = v\frac{dm}{dt} = 1000\times 0.1$

Now, $\quad F = Ma$

$\therefore\ a = \frac{1000\times 0.1}{100} = 1\ \text{ms}^{-2}$

35 **(b)**

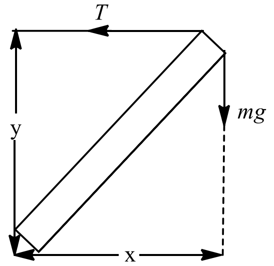


Frictional force $= f = 28.2\cos 45° = 28.2\times\frac{1}{\sqrt{2}} = 20N$

Normal reaction $R = 50 - 28.2\sin 45° = 30\ N$

36 **(a)**

For equilibrium of street light,



$mg\times x = T\times y$ or $T = \frac{mgx}{y}$

For T to be minimum y should be maximum.

Hence, pattern A is more sturdy.

37 **(c)**

If T is tension in each part of the string holding mass $\sqrt{2}m$, then in equilibrium,

$T\cos\theta + T\cos\theta = \sqrt{2}mg$

$2T\cos\theta = \sqrt{2}mg$

But $T = mg$; $\therefore 2mg\cos\theta = \sqrt{2}mg$

$\cos\theta = \frac{1}{\sqrt{2}}$

$\theta = 45°$

38 **(c)**

Net force on the body = Applied force − Friction

$ma = F - \mu_k mg \Rightarrow \mu_k = \frac{F - ma}{mg}$

$$= \frac{129.4 - 10\times 10}{10\times 9.8} = 0.3$$

39 **(d)**

Equations of motion are

$m_1 a = T - m_1 g$

and $m_2 a = m_2 g - T$

$\Longrightarrow$ $8a = T - 8g$ ....(i)

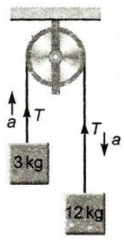
$12a = 12g - T$ ....(ii)

Form Eqs. (i) and (ii), we get

$a = \frac{g}{5} = 2\ \mathrm{m/s^2}$

Substituting the value of a in Eq.(i)

We get $T = 96$ N



40 **(a)**

$F_{av} = \frac{\Delta p}{\Delta t} = \frac{mv - (-mv)}{\Delta t} = \frac{2mv}{\Delta t} = \frac{2\times 0.5\times 2}{10^{-3}}$

$= 2000N$

41 **(b)**

Newton second law

$F = ma \Rightarrow 6 = (7+5)a\ ; a = \frac{1}{2}\frac{m}{s^2}; F' \to 5\ kg$

Now, $F' = 5\times\frac{1}{2} = 2.5\ N$

43 **(a)**

$F = m\left(\frac{dv}{dt}\right) = \frac{100\times 5}{0.1} = 5000\ N$

44 **(c)**

If momentum remains constant, the force will be zero because

$F = \frac{dp}{dt}$

45 **(b)**

$0.05v = (0.450 + 0.05)V$

or $V = \frac{0.05}{0.50}v = \frac{v}{10}$

Using $v^2 - u^2 = 2as$, we get

$0^2 - \left(\frac{v}{10}\right)^2 = -2\times 10\times 1.8$

or $\left(\frac{v}{10}\right)^2 = 36$ or $v = 60\ \mathrm{ms^{-1}}$

46 **(d)**

$mg\sin\theta = ma$

$\therefore$ $a = g\sin\theta$

Where a is long the inclined plane.

$\therefore$ Vertical component of acceleration is $g\sin^2\theta$.

$\therefore$ Relative vertical acceleration of A with respect to B is

$g(\sin^2 60° - \sin^2 30°) = \frac{g}{2} = 4.9\ \mathrm{ms^{-2}}$

(in vertical direction)

47 **(b)**

From $s = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2}at^2$

$t = \sqrt{\frac{2s}{a}}$

For smooth plane, $a = g\sin\theta$

For rough plane, $a' = g\ (\sin\theta - \mu\cos\theta)$

$\therefore$ $t' = \sqrt{\frac{2s}{g\,(\sin\theta - \mu\cos\theta)}} = nt = n\sqrt{\frac{2s}{g\sin\theta}}$

$\therefore$ $n^2 g(\sin\theta - \mu\cos\theta) = g\sin\theta$

When $\theta = 45°, \sin\theta = \cos\theta = 1/\sqrt{2}$

Solving we get $\mu = 1 - \frac{1}{n^2}$

48 **(a)**

Velocity by which the ball hits the bat

$v_1 = \sqrt{2gh_1} = \sqrt{2\times 10\times 5}$ or $\overrightarrow{v_1} = +10m/s = 10\ m/s$

Velocity of rebound

$v_2 = \sqrt{2gh_2} = \sqrt{2\times 10\times 20} = 20\ m/s$ or $\overrightarrow{v_2} = -20\ m/s$

$F = m\frac{dv}{dt} = \frac{m(\overrightarrow{v_1} - \overrightarrow{v_2})}{dt} = \frac{0.4(-10-20)}{dt}$

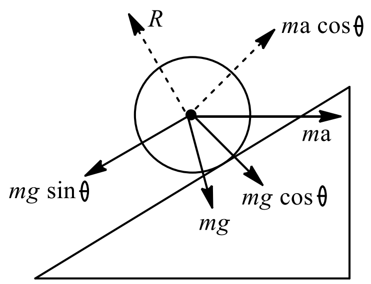
$= 100\ N$

By solving $dt = 0.12$ sec

49 **(c)**

Here, $\sin\theta = \frac{1}{l}$

Let required acceleration of inclined plane be a for the object to remain stationary relative to incline, we have



$ma\cos\theta = mg\sin\theta$

$$a = g\tan\theta = g\frac{1}{\sqrt{l^2-1}}$$

50 **(a)**

Initial velocity of ball $= v$

When it strikes the wall normally and reflected back, then final velocity $= -v$

Change in velocity $= v — v = 2v$

Force exerted by the ball on the wall is given by Newton's second law, *ie*,

$F = ma$

$= \frac{m\,\Delta v}{\Delta t}$

$= \frac{m(2v)}{t} = \frac{2\,mv}{t}$

51 **(d)**

Effective value of acceleration due to gravity in the lift = g − a

Acceleration down the inclined plane

Using, $s = ut + \frac{1}{2}at^2$, we get

$l = \frac{1}{2}(\mathrm{g} - a)\sin\theta t^2$,we get

$$t = \sqrt{\frac{2l}{(\mathrm{g}-a)\sin\theta}}$$

53 **(c)**

$u_y = 40\ m/s, F_y = -5\ N, m = 5\ kg$

So $a_y = \frac{F_y}{m} = -1\ m/s^2$ (As $v = u + at$)

$\therefore v_y = 40 - 1 \times t = 0 \Rightarrow t = 40\ sec$

54 **(c)**

$$\vec{F}\Delta t = m\Delta\vec{v} \Rightarrow F = \frac{m\Delta\vec{v}}{\Delta t}$$

By doing so time of change in momentum increases and impulsive force on knees decreases

55 **(b)**

$R^2 = (3P)^2 + (2P)^2 + 2 \times 3P \times 2P \times \cos\theta$ ...(i)

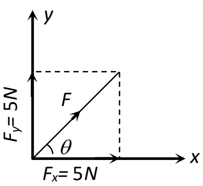
$(2R)^2 = (6P)^2 + (2P)^2 + 2 \times 6P \times 2P \times \cos\theta$ ...(ii)

By solving (i) and (ii), $\cos\theta = -1/2 \Rightarrow \theta = 120°$

56 **(c)**

$$l = l_0\sqrt{1-\frac{v^2}{c^2}} = 1\sqrt{1-\left(\frac{2.7\times10^8}{3\times10^8}\right)^2} \Rightarrow l$$
$$= 0.44\ m$$

57 **(b)**



$|\vec{F}| = \sqrt{5^2 + 5^2} = 5\sqrt{2}N$

And $\tan\theta = \frac{5}{5} = 1$

$\Rightarrow \theta = \pi/4$

58 **(c)**

Impulse = Change in momentum $= m(v_2 - v_1)$ ...(i)

Again impulse = Area between the graph and time axis

$= \frac{1}{2} \times 2 \times 4 + 2 \times 4 + \frac{1}{2}(4 + 2.5) \times 0.5 + 2 \times 2.5$

$= 4 + 8 + 1.625 + 5 = 18.625$ ...(ii)

From (i) and (ii), $m(v_2 - v_1) = 18.625$

$\Rightarrow v_2 = \frac{18.625}{m} + v_1 = \frac{18.625}{2} + 5 = 14.25\ m/s$

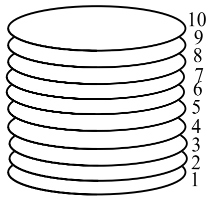
59 **(c)**

When lift is at rest, $T = 2\pi\sqrt{l/g}$

If acceleration becomes $g/4$ then

$$T' = 2\pi\sqrt{\frac{l}{g/4}} = 2\pi\sqrt{\frac{4l}{g}} = 2 \times T$$

60 **(d)**



(a) Is correct 6th coin has four coins on its top which exert a force $4mg$ on it

(b) Is correct. 7th coin has three coins, placed over it. Thus 7th coin exerts a force $4mg$ on 6th coin (downwards)

(c) Is correct. As what is explained in (b), the reaction of 6th coin on the 7th coin is $4mg$ (upwards)

(d) Is wrong 10th coin, which is the topmost coin, experiences a reaction force of mg (upwards) from all the coins below it

61 **(a)**

Acceleration

$a = \frac{F}{m} = \frac{4}{20} = \frac{1}{5}\mathrm{ms^{-2}}$

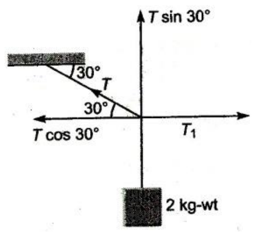
Distance covered by body in 3rd second

$= \frac{1}{2} \times \frac{1}{5} \times (2 \times 3 - 1) = \frac{5}{10} = \frac{1}{2}\mathrm{m}$

$\therefore\ W = 4 \times \frac{1}{2} = 2\mathrm{J}$

62 **(c)**

$T\sin 30° = 2$ kg-wt



$\Rightarrow T = 4$ kg-wt

$T_1 = T\cos 30° = 4\cos 30° = 2\sqrt{3}$

63 **(b)**

$\dfrac{mg}{m(g-a)} = \dfrac{3}{2} \Rightarrow a = g/3$

64 **(c)**

$f_{ms} = 0.4t \times 10\text{N} = 4$ N

The applied force is less than f_{ms}. So, the block would not move

65 **(a)**

Angle of repose $\alpha = \tan^{-1}(\mu) = \tan^{-1}(0.8) = 38.6°$

Angle of inclined plane is given $\theta = 30°$. It means block is at rest therefore,

Static friction = component of weight in downward direction $= mg\sin\theta = 10\ N$ $\therefore m = \frac{10}{g\times\sin 30°} = 2\ kg$

66 **(a)**

Given that $\vec{P} = P_x i + P_y\hat{j} = 2\cos t\,\hat{\imath} + 2\sin t\,\hat{j}$

$\therefore \vec{F} = \dfrac{d\vec{p}}{dt} = -2\sin t\,\hat{\imath} + 2\cos t\,\hat{j}$

Now, $\vec{F}.\vec{p} = 0 i.e.$ angle between $\vec{F}$ and $\vec{P}$ is 90°

67 **(a)**

Relating force $F = ma = \mu R = \mu mg$

$\therefore a = \mu g$

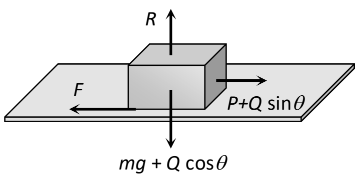
Now from equation of motion $v^2 = u^2 - 2as$

$\Rightarrow 0 = u^2 - 2as \Rightarrow s = \dfrac{u^2}{2a} = \dfrac{u^2}{2\mu g}$

$\therefore s = \dfrac{v_0^2}{2\mu g}$

69 **(a)**

By drawing the free body diagram of the block for critical condition



$F = \mu R \Rightarrow P + Q\sin\theta$

$= \mu\,(mg + Q\cos\theta)$

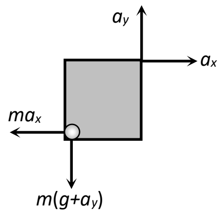
$\therefore \mu = \dfrac{P + Q\sin\theta}{mg + Q\cos\theta}$

70 **(c)**

As $\vec{v} = 5t\hat{\imath} + 2t\hat{j}$ $\therefore \vec{a} = a_x\hat{\imath} + a_y\hat{j} = 5\hat{\imath} + 2\hat{j}$

$F = ma_x\hat{\imath} + m(g + a_y)\hat{j}$

$\therefore |\vec{F}| = m\sqrt{a_x^2 + (g + a_y)^2} = 26\ N$



71 **(d)**

$R = m(g + a) = m(g + g) = 2mg$

72 **(a)**

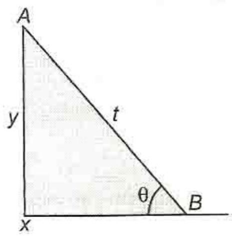
Acceleration $= \frac{m_2}{m_1+m_2} \times g = \frac{1}{2+1} \times 9.8 = 3.27\ m/s^2$

and $T = m_1 a = 2 \times 3.27 = 6.54\ N$

73 **(b)**

From geometry, it is clear that $x = l\cos\theta$ and $y = l\sin\theta$

$\therefore\ v_x = \frac{dx}{dv} = -l\sin\theta\frac{d\theta}{dt}$ and $v_y = \frac{dy}{dt} = l\cos\theta\frac{d\theta}{dt}$



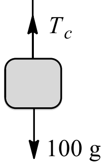
$\therefore\ \dfrac{v_y}{v_x} = -\cot\theta$ or $v_y = -v_x\cot\theta$

Since, $v_x = -3\ \text{ms}^{-1}$, hence

$v_y = -(-3)\cot 60° = 3 \times \dfrac{1}{\sqrt{3}} = \sqrt{3}\text{ms}^{-1}$

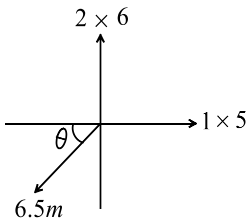
74 **(b)**

$T_C = 100$ g



75 **(b)**

Resolve momentum 6.5 $m$along x and y axes and equate



$\therefore 6.5\,m\cos\theta = 5 \times 1$

and $6.5\,m\sin\theta = 6 \times 2$

$\Rightarrow (6.5\,m)^2 = (5)^2 + (12)^2$

$\Rightarrow 6.5m = 13 \Rightarrow m = 2\ kg$

$\therefore$ Total mass $= 1+2+2 = 5kg$

76 **(d)**

Momentum acquired = Area of force – time graph

$= \frac{1}{2} \times (2) \times (10) + 4 \times 10$

$= 50$ N-S

77 **(d)**

Initial thrust $mg + ma = m(g + a)$

$= 10^5(10+5)$N

$= 1'5 \times 10^5$N $= 1.5 \times 10^6$N

78 **(c)**

Tension the string $= m(g+a) =$ Breaking force

$\Rightarrow 20(g+a) = 25 \times g \Rightarrow a = g/4 = 2.5\ m/s^2$

79 **(d)**

Force $F = \frac{dp}{dt}$

$= v\left[\frac{dM}{dt}\right]$

$= \alpha v^2$

$\therefore \quad a = \frac{F}{M} = \frac{\alpha v^2}{M}$

80 **(d)**

Force on the car

$F = \mu R$

or $ma = \mu mg \quad (\because R = mg)$

or $a = \mu g$

Now from 2nd equation of motion

$s = ut + \frac{1}{2}at^2$

or $s = 0 + \frac{1}{2}at^2 \quad (\because u = 0)$

or $t = \sqrt{\frac{2s}{\mu g}}$

$\therefore t = \sqrt{\frac{2s}{\mu g}}$

or $t \propto \frac{1}{\sqrt{\mu}}$

81 **(c)**

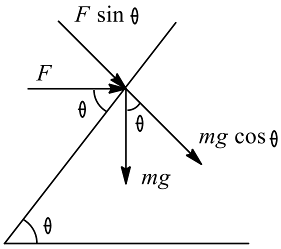
As the spring balances are massless therefore the reading of both balance should be equal

82 **(d)**

$\mu_s = \frac{m_B}{m_A} \Rightarrow 0.2 = \frac{m_B}{2} \Rightarrow m_B = 0.4\ kg$

83 **(d)**

As is clear from figure



$R = mg \sin\theta + F \sin\theta$

$R = mg\cos\theta + F\sin\theta$

84 **(a)**

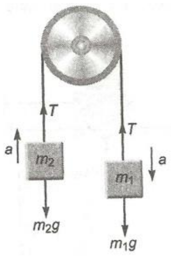
Acceleration of block in a stationary lift $= g\sin\theta$

If lift is descending with acc. then it will be $(g-a)\sin\theta$ but in the problem acceleration $= -a$ (retardation)

$\therefore$ Acceleration of block $= [g-(-a)]\sin\theta = (g+a)\sin\theta$

85 **(a)**

The free body diagram showing the various forces acting on the pulley mass are as follows



Equating the vertical forces, we have

$m_1g - T = m_1a$ ...(i)

$T - m_2g = m_2a$ ...(ii)

From Eqs. (i) and (ii), we get

$a = \frac{m_1g - m_2g}{m_1+m_2}$ ....(iii)

The acceleration of centre of mass is

$a_{CM} = \frac{m_1a - m_2a}{m_1+m_2}$

Putting the value of a from Eq. (iii), we get

$a_{CM} = \frac{(m_1-m_2)^2}{(m_1+m_2)^2}g$

86 **(b)**

$f = \mu R = \mu mg|m$is mass of the combination

$f = 0.5 \times 10 \times 10$ N $= 50$ N

So, a force of 10 N is unable to start the motion of the system. There is no relative motion between A and B

87 **(d)**

Force acting on plate, $F = \frac{dp}{dt} = v\left(\frac{dm}{dt}\right)$

Mass of water reaching the plate per $sec = \frac{dm}{dt}$

$= Av\rho = A(v_1+v_2)\rho = \frac{V}{v_2}(v_1+v_2)\rho$

($v = v_1 + v_2 =$ velocity of water coming out of jet $w.r.t.$ plate)

$$\left[A = \text{Area of cross section of jet} = \frac{V}{v_2}\right]$$

$$\therefore F = \frac{dm}{dt}v = \frac{V}{v_2}(v_1+v_2)\rho \times (v_1+v_2)$$

$$= \rho\left[\frac{V}{v_2}\right](v_1+v_2)^2$$

88 **(c)**

Acceleration $a = \dfrac{\Delta v}{\Delta t} = \dfrac{v}{m}\cdot\dfrac{\Delta m}{\Delta t}$

$= \dfrac{50}{2} \times 0.1 = 2.5\ \text{ms}^{-2}$

89 **(d)**

$\Delta p = 2mv = 2 \times 0.25 \times 10 = 5\ \text{kg m/s}$

$F = \dfrac{\Delta p}{\Delta t} = \dfrac{5}{0.01} = 500\ \text{N}$

90 **(a)**

Let the tension in the wire be T. The equations of motion of the two locks are,

$T - 10 = 1\,a$

and $20 - T = 2\,a$

Eliminating a form these equations,

$T = \left(\dfrac{40}{3}\right)\text{N}$

Stress, $T = \dfrac{\left(\frac{40}{3}\right)}{\pi r^2}$

If the minimum radius needed to avoid breakings is r.

$2 \times 10^9 = \dfrac{\left(\frac{40}{3}\right)}{\pi\ r^2}$

Solving this,

$r = 4.6 \times 10^{-5}\ \text{m}$

91 **(b)**

$u = 2m/s, v = 0, t = 10\ \text{sec}$

$\therefore a = \dfrac{v-u}{t} = \dfrac{0-2}{10} = -\dfrac{2}{10} = -\dfrac{1}{5} = -0.2\ m/s^2$

$\therefore$Friction force$= ma = 1 \times (-0.2) = -0.2\ N$

92 **(b)**

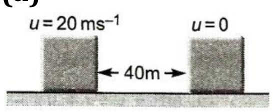
The accelerating force of the rocket

$= \text{upward thrust} = \dfrac{\Delta m}{\Delta t}\cdot v$

Given, $\dfrac{\Delta m}{\Delta t} = 50 \times 10^{-3}\text{kgs}^{-1}$, $\quad v = 400\ \text{ms}^{-1}$

So, accelerating force $= 50 \times 10^3 \times 400 = 20$ N

93 **(a)**



From equation of motion

$v^2 = u^2 - 2as$

Where v is final velocity, u the initial velocity, a acceleration and s the displacement.

Given, $v = 0, u = 20\ \text{ms}^{-1}, s = 40$ m

$\therefore\quad 0 = (20)^2 - 2 \times 40 \times a$

$\Rightarrow a = 5\ \text{ms}^{-2}$

Kinetic (or dynamic) friction occurs when two objects are moving relative to each other and rub together. It is given by

$\mu_x = \dfrac{a}{g} = \dfrac{5}{10} = 0.5$

94 **(d)**

In this case the internal force is applied on the system, so he will not succeed. According to Newton's law the state of a body can only be changed if some external force is applied on it.

95 **(d)**

Coefficent of friction $\mu = \dfrac{F}{R}$

$= \dfrac{mg/3}{2mg/3} = \dfrac{1}{2}$

96 **(c)**

Mass measured by physical balance remains unaffected due to variation in acceleration due to gravity

97 **(a)**

$a = \left[\dfrac{m_1 - m_2}{m_1 + m_2}\right]g = \left[\dfrac{5-4.8}{5+4.8}\right] \times 9.8 = 0.2\ m/s^2$

98 **(d)**

If rope of lift breaks suddenly, acceleration becomes equal to g so that tension, $T = m(g-g) = 0$

99 **(b)**

In the given system,

$a = \dfrac{m_1 - m_2}{m_1 + m_2} = \dfrac{g}{8}$

$\therefore\ \dfrac{m_1 - m_2}{m_1 + m_2} = \dfrac{1}{8}$

$8m_1 - 8m_2 = m_1 + m_2$

$7m_1 = 9m_2$

$\dfrac{m_1}{m_2} = \dfrac{9}{7}$

101 **(c)**

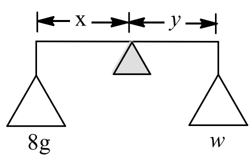
Reading =Weight of cage + Reaction by bird

$= 20 + 0.5(10+2) = 26\ N$

102 **(b)**

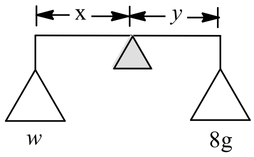
$8x = wy$

$\dfrac{x}{y} = \dfrac{w}{8}\quad$ ...(i)



$wx = 18y$

$\dfrac{x}{y} = \dfrac{18}{w}\quad$ ...(ii)



Dividing Eq. (i) by Eq. (ii)

$$\frac{\frac{x}{y}}{\frac{x}{y}} = \frac{\frac{w}{8}}{\frac{18}{w}}$$

$\Rightarrow\ w = \sqrt{18 \times 8} = 12\text{g}$

103 **(d)**

Net force =Applied force − Friction force

$ma = 24 - \mu mg = 24 - 0.4 \times 5 \times 9.8$

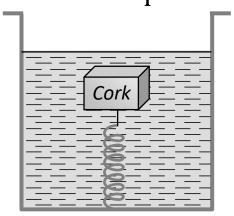
$= 24 - 19.6$

$\Rightarrow a = \dfrac{4.4}{5} = 0.88\ m/s^2$

104 **(b)**

Density of cork $= d$, Density of water $= \rho$

Resultant upward force on cork $= V(\rho - d)g$



This causes elongation in the spring. When the lift moves down with acceleration a, the resultant upward force on cork $= V(\rho - d)(g - a)$ which is less than the previous value. So the elongation decreases

105 **(b)**

$v = \sqrt{\mu rg} = \sqrt{0.4 \times 30 \times 9.8} = 10.84\ m/s$

106 **(c)**

Impulse = Area between force and time graph and it is maximum for graph (III) and (IV)

107 **(a)**

$F = \dfrac{W}{\mu}\ \therefore W = \mu F = 0.2 \times 10 = 2N$

108 **(c)**

Let P force is acting at an angle 30° with the horizontal

For the condition of motion $F = \mu R$

$P\cos 30° = \mu(mg - P\sin 30°)$

$\Rightarrow P\dfrac{\sqrt{3}}{2} = \dfrac{1}{\sqrt{3}}\left(100 - P\dfrac{1}{2}\right) \Rightarrow \dfrac{3P}{2} = \left(100 - \dfrac{P}{2}\right)$

$\Rightarrow 2P = 100 \therefore P = 50\ N$

109 **(b)**

Force exerted by the ball

$\Rightarrow F = m\left(\dfrac{dv}{dt}\right) = 0.15 \times \dfrac{20}{0.1} = 30\ N$

110 **(c)**

Apparent weight of ball

$w' = w - R$

$R = ma$acts upward $= ma$

$w' = mg - ma = m(g - a)$

Hence, apparent acceleration in the lift is $g - a$. Now if the man is standing stationary on the ground, then the apparent acceleration of the falling ball is g.

111 **(b)**

$dp = F \times dt = 10 \times 10 = 100\ kgm/s$

112 **(c)**

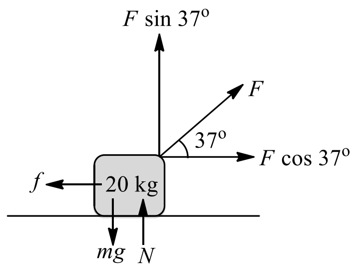
For accelerated upward motion

$R = m(g + a) = 80\ (10 + 5) = 1200\ N$

113 **(b)**

The work done by the force is F cos 37°,

Where $F\cos 37° = f = \mu N$



In this case, $N = mg - F\sin 37°$,

So that, $F = \frac{\mu mg}{(\cos 37° + \mu \sin 37°)}$

Here, $\mu = 0.40$ and $m = 20$ kg

$\therefore\ F = 75.4$ N

Hence, $W = (75.4\cos 37°)(8.0) = 482$ J

114 **(d)**

Force $2mg$applied at the free end of the string acts on mass m. Therefore, its acceleration

$a = \dfrac{\text{Force}}{\text{mass}}$

$= \dfrac{2mg}{m} = 2\text{g}$

115 **(c)**

Due to acceleration in forward direction, vessel is in an accelerated frame therefore a Pseudo force will be exerted in backward direction. Therefore water will be displaced in backward direction

116 **(a)**

Given, $m_1 = 1\text{kg}, m_2 = 2$ kg and $g = 10\text{m/s}^2$

$a = \left(\dfrac{m_2 - m_1}{m_1 + m_2}\right)g$

$= \left(\dfrac{2-1}{1+2}\right)10 = \dfrac{10}{3}$

$S = \dfrac{1}{2}at^2$

$= \dfrac{1}{2} \times \dfrac{10}{3} \times 4 = \dfrac{20}{3}$

$m = \dfrac{2 \times \frac{20}{3} - 1 \times \frac{20}{3}}{3} = \dfrac{20}{9}$

117 **(b)**

Velocity $u = 72\ \text{kmh}^{-1} = 20\ \text{ms}^{-1}$

$a = \mu g = 0.5 \times 10\ \text{ms}^{-2}$

From $\quad v^2 = u^2 - 2as$

$\therefore\ (0)^2 = (20)^2 - 2 \times 0.5 \times 10 \times s$

$\therefore s = \dfrac{20 \times 20}{2 \times 0.5 \times 10}$ or $s = 40\text{m}$

118 **(a)**

Friction is the retarding force for the block

$F = ma = \mu R = \mu mg$

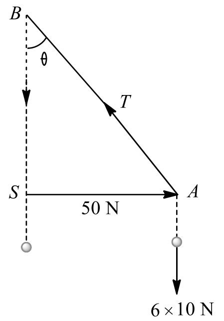
Retardation $a = \mu g$

From first equation to motion $v = u - at$

$\Rightarrow 0 = V - \mu g \times t \Rightarrow t = \dfrac{V}{g\mu}$

119 **(d)**

The three forces acting on the mass at location A have been shown in figure. Since the mass is in equilibrium, therefore, the three forces acting on the mass must be represented by the three sides of a triangle taken in one order. Hence



$\frac{50}{SA} = \frac{6\times10}{SB}$ or $\frac{SA}{SB} = \frac{50}{60} = \frac{5}{6}$

or $\tan\theta = \frac{SA}{SB} = \frac{5}{6} = 0.8333$

$= \tan 40°$

$\therefore \theta = 40°$

120 **(d)**

$u = 250\ m/s, v = 0, s = 0.12\ metre$

$F = ma = m\left(\dfrac{u^2 - v^2}{2s}\right) = \dfrac{20 \times 10^{-3} \times (250)^2}{2 \times 0.12}$

$\therefore F = 5.2 \times 10^3 N$

121 **(d)**

The situation is shown in figure. At initial time, the ball is at P, then under the action of a force (exerted by hand) from P to A and then from A to B, let acceleration of ball during PA is $a\text{ms}^{-2}$[assumed to be constant] in upward direction and velocity of ball at A is $v\text{ms}^{-1}$.

Then for PA, $v^2 = 0^2 + 2a \times 0.2$

For AB, $0 = v^2 - 2 \times g \times 2$

$\Longrightarrow v^2 = 2g \times 2$

From above equation,

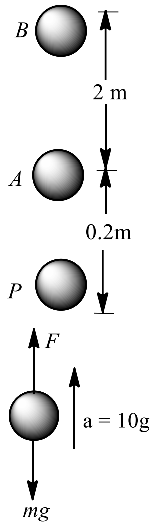
$a = 10g = 100\ \text{ms}^{-2}$

Then for PA, FBD of ball is

$F - mg = ma$ [F is the force exerted by hand on ball]

$\Longrightarrow F = m(g + a) = 0.2\ (11g)$

$= 22\ \text{N}$



123 **(a)**

$W = \mu mgS = 0.2 \times 50 \times 9.8 \times 1 = 98\,J$

124 **(d)**

$T = \dfrac{2m_1m_2}{m_1 + m_2}g = \dfrac{2 \times 10 \times 6}{10 + 6} \times 9.8 = 73.5\ N$

125 **(d)**

$u =$ velocity of bullet

$\frac{dm}{dt} =$ Mass of bullet fired per second by the gun

$\frac{dm}{dt} =$ Mass of one bullet $(m_B) \times$ Bullets fired per sec (N)

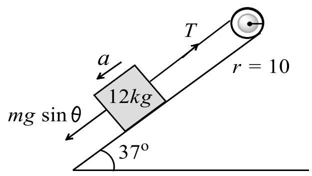
Maximum force that man can exert $F = u\left(\frac{dm}{dt}\right)$

$\therefore F = u \times m_B \times N$

$\Rightarrow N = \dfrac{F}{m_B \times u} = \dfrac{144}{40 \times 10^{-3} \times 1200} = 3$

126 **(a)**

$T = m_1 g \sin\theta - m_1 a$



$T = 12 \times 10 \sin 37 - 12 \times 2$

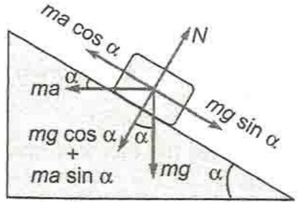
$T = 120 \times 0.6018 - 24$

$T = 72.21 - 24 = 48.21 = 48$

127 **(a)**

Since, $P = (M + m)a$

Now as in free body diagram of block,



$ma\cos\alpha = mg\sin\alpha$

$\therefore\ a = g\frac{\sin\alpha}{\cos\alpha} = g\tan\alpha$ or $P = (M+m)g\tan\alpha$

128 **(a)**

Since, $F = \frac{\Delta p}{\Delta t}$

or $\Delta p = F\,\Delta t$

We can say that momentum between 0 to 7 s is equal to the vector area enclosed by the force-time graph from 0 to 7 s. So, Change in linear momentum

= vector area of triangle OAB + vector area of square BCDE+ vector area of triangle EFG + vector area of square $GHIJ$+ vector area of triangle JKL

$$= \left[\frac{1}{2}\times 1\times(-1)\right] + [2\times 2] + \left[\frac{1}{2}\times 2\times(-2)\right] + [1\times 1] + \left[\frac{1}{2}\times 1\times(-1)\right]$$

$$= -\frac{1}{2} + 4 - 2 + 1 - \frac{1}{2} = 2\text{ Ns}$$

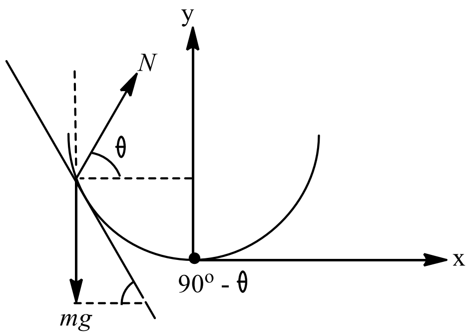
129 **(d)**

$N\sin\theta = mg$

$N\cos\theta = ma$

$\tan\theta = \frac{g}{a}$

$\cos\theta = \frac{a}{8} = \tan(90° - \theta) - \frac{dy}{dx} = 2kx$



$\therefore x = \frac{a}{2kg}$

130 **(b)**

Mass of each bullet$(m) = 1\text{ g} = 0.001\text{ kg}$

Velocity of bullet $(v) = 10\text{ ms}^{-1}$

Applied force $(F) = 5$ g-wt.

$= \frac{5}{1000}\times 10\text{ N}$

$= 0.05\text{ N}$

Let n bullets are fired per second, then

Force= rate of change of linear momentum

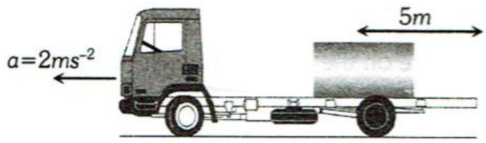
ie, $F = n\times mv$

$\therefore$ Number of bullets fired per second

$n = \frac{F}{mv}$

$= \frac{0.05}{0.001\times 10} = 5$

131 **(a)**



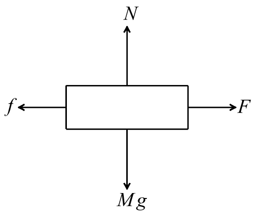
Here, Mass of the box, $M = 40\ kg$

Acceleration of the truck, $a = 2\ ms^{-2}$

Distance of the box from the rear end , $d = 5m$

Coefficient of friction between the box and the surface below it, $\mu = 0.15$

The various forces acting on the block are as shown in the figure



As the truck moves in forward direction with the acceleration $a = 2ms^{-2}$, the box experiences a force F in the backward direction and it is given by

$f = Ma = (40\ kg)\times(2\ ms^{-2}) = 80\ N$ in backward direction

Under the action of this force, the box will tend to move toward the rear end of the truck . As it does so, its motion will be opposed by the force of friction which acts in the forward direction and it is given by

$f = \mu N = \mu Mg = 0.15\times 40\times 10 = 60\ N$

The acceleration of the box relative to the truck toward the rear end is, $a_1 = \frac{F-f}{M} = \frac{80\ N - 60\ N}{40\ kg} = 0.5\ ms^{-1}$

Let t be the time taken for the box to fall off the truck

Using, $S = ut + \frac{1}{2}at^2$, we get , $d = 0\times t + \frac{1}{2}a_1t^2 [\because u = 0]$

$5 = \frac{1}{2}\times 0.5\times t^2, t = \sqrt{\frac{2\times 5}{0.5}} = \sqrt{20}s$

During this time, the truck covers a distance x

Using $S = ut + \frac{1}{2}at^2$

We get $x = 0\times t + \frac{1}{2}\times 2\times\left(\sqrt{20}\right)^2 [\because u = 0]$

$x = 20\ m$

132 **(c)**

Acceleration $a = \frac{1}{m}\left(\frac{-dm}{dt}\right)v_r = \frac{1}{1}\left(\frac{1}{60}\right) \times 2400 = 40\ ms^{-2}$

133 **(d)**

By law of conservation of linear momentum.

$m_1\mathbf{v}_1 + m_2\mathbf{v}_2 + m_3\mathbf{v}_3 = 0$

Here $m_1 = m_2 = m_3 = 1$ kg,

$\mathbf{v}_1 = 3\,\hat{\mathbf{i}}, \mathbf{v}_2 = 4\,\hat{\mathbf{j}}$

$\therefore\ 3\,\hat{\mathbf{i}} + 4\,\hat{\mathbf{j}} + \mathbf{u}_3 = 0$

The average force acting on the third piece is

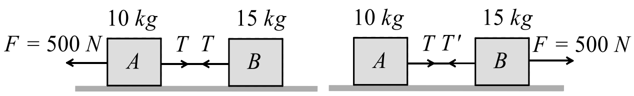
$F = \frac{m\mathbf{v}_3}{t}$

$= \frac{1 \times -(3\,\hat{\mathbf{i}} + 4\,\hat{\mathbf{j}})}{10^4}$N

$= -(3\,\hat{\mathbf{i}} + 4\,\hat{\mathbf{j}}) \times 10^4$N

134 **(d)**

Acceleration $= \frac{500}{25} = 20\ m/s^2$ in both the cases



In fig 1, $T = 500 - 10 \times 20 = 300\ N$

In fig 2, $T'' = 500 - 15 \times 20 = 200\ N$

135 **(b)**

Applying law of conservation of liner momentum, *ie*,

$m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$

Here, $m_1 = 10\text{ g} = 10^{-2}\text{ kg}, m_2 = 5\text{ kg}$

$u_1 = 300\text{ ms}^{-1}, u_2 = 0$

$v_1 = 0, v_2 = ?$

$\therefore\ 10^{-2} \times 300 + 5 \times 0 = 10^{-2} \times 0 + 5v_2$

or $5v_2 = 3$

or $v_2 = \frac{3}{2}\text{ms}^{-1}$

$= 60\text{ cms}^{-1}$

136 **(d)**

$\mu = \frac{F}{R} = \frac{F}{mg} = \frac{98}{100 \times 9.8} = \frac{1}{10} = 0.1$

139 **(a)**

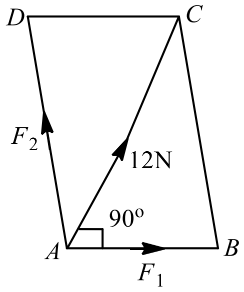
Work done = Force × displacement = $\mu mg \times (v \times t)$

$W = (0.2) \times 2 \times 9.8 \times 2 \times 5\ joule$

Heat generated $Q = \frac{W}{J} = \frac{0.2\times2\times9.8\times2\times5}{4.2} = 9.33\ cal$

140 **(c)**

Let smaller force be F_1. Resultant R of the forces is at 90° to AB,



$\therefore\ R^2 + F_1^2 = F_2^2$ in ΔABC

or $(12)^2 = F_2^2 - F_1^2$ …… (i)

or $144 = (F_2 - F_1)(F_2 + F_1)$

but $F_1 + F_2$ =18 N (given) ….(ii)

$\therefore\ F_2 - F_1 = \frac{144}{18} = 8$ …..(iii)

From Eqs. (ii) and (iii), $F_1 = 5,\ \ F_2 = 13$

Hence, forces are 5 N and 13 N.

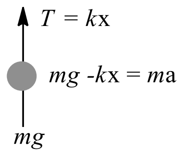
141 **(c)**

For minimum mass of m, mass M breaks off contact when elongation in spring is maximum

At the time of break off, block A is at lowest position and its speed is zero. At an instant t_1

$mg - kx = ma$

$v\frac{dv}{dx} = \frac{mg - kx}{m}$



$\int_0^0 vdv = \int_0^x \left(g - \frac{k}{m}x\right)dx$

Where x_0 is maximum elongation is spring

$0 = gx_0 - \frac{kx_0^2}{2m}$

$x = \frac{2mg}{k}$

At the time of break off of block B

$Mg = kx_0$

$Mg = 2mg$

$m = \frac{M}{2}$

142 **(b)**

Acceleration produced in jet $= \frac{\text{Change in velocity}}{\text{Time}}$

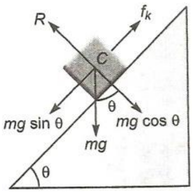
$a = \frac{(10^3 - 0)}{10} = 100\ m/s^2$

$\therefore$ Mass $= \frac{\text{Force}}{\text{Acceleration}} = \frac{10^5}{10^2} = 10^3 kg$

143 **(b)**

The various forces acting on the block are as shown

From Newton's law



$mg \sin\theta - f = ma$ ....(i)

Where f is frictional force and a the acceleration downwards.

Since, there is no motion perpendicular to surface, we have

$R - mg\cos\theta = 0$

$\Rightarrow R = mg\cos\theta$ ....(ii)

Also, $f = \mu R = \mu\, mg\cos\theta$

Putting the value in Eq. (i) we get

$mg\sin\theta - \mu\, mg\cos\theta = ma$

$\Rightarrow a = g\sin\theta - \mu\, g\cos\theta$

Now, velocity at bottom

$v^2 = u^2 - 2as$

Since, $v = 0$

$\therefore u = \sqrt{2as}$

Given, $s = l$, $a = g\sin\theta - g\mu\cos\theta$

$\therefore\ u = \sqrt{2l(g\sin\theta - g\mu\cos\theta)}$

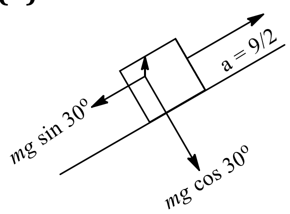
$u = \sqrt{2gl(\sin\theta - \mu\cos\theta)}$

144 **(b)**

Weight of body $= 2 \times 10 = 20$ N

This force has the tendency to move the block, so friction force = 20 N.

145 **(b)**



$T\sin\theta - mg\sin\theta = ma$

$T\sin\theta = mg\sin\theta + \frac{mg}{2}$ ...(i)

$T\cos\theta = mg\cos\theta$ ...(ii)

Dividing Eq. (i) by Eq. (ii), we get

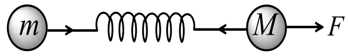
$\tan\theta = \frac{2}{\sqrt{3}}$

146 **(d)**

Kinetic energy being a scalar quantity, hence measured from different inertial frame gives the same value, while the other three being vector quantities their values vary.

147 **(c)**

Acceleration of the system $= \frac{F}{M+m}$ and



Force on the block $m = Kx = ma = \frac{mF}{m+M}$

148 **(b)**

Rate of flow will be more when lift will move in upward direction with some acceleration because the net downward pull will be more and vice-versa

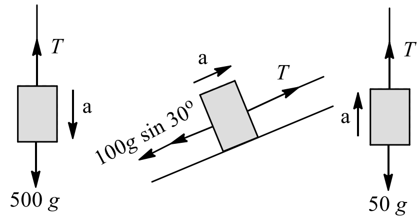
$F_{\text{upward}} = m(g+a)$ and $F_{\text{downward}} = m(g-a)$

149 **(c)**

$500\text{g} - T = 500a$

$T - 100\text{g}\sin 30° - T' = 100a$

or $T - T' - 50\text{g} = 100a$



Again, $T' - 50\text{g} = 50a$

From Eqs. (ii) and (iii)

$T - 100\text{g} = 150a$

Adding Eqs. (i) and (iv), $400\text{g} = 650\ a$ or $a = \frac{400\text{g}}{650} = \frac{8\text{g}}{13}$

This acceleration is downwards

150 **(a)**

FBD of mass 2 kgFBD of mass 4kg

$TT' - 19.6 = 4$ ... (i)

$T' - 39.2 = 8$ ... (ii)

From (ii), $T' = 47.2\ N$

And substituting T' in (i), we get

$T = 4 + 19.6 + 47.2 \Rightarrow T = 70.8\ N$

151 **(a)**

$\mu = \tan\theta\left(1 - \frac{1}{n^2}\right) = \tan\theta\left(1 - \frac{1}{2^2}\right) = \frac{3}{4}\tan\theta$

152 **(c)**

Momentum of one piece $= \frac{M}{4} \times 3$

Momentum of the other piece $= \frac{M}{4} \times 4$

$\therefore$ Resultant momentum $= \sqrt{\frac{9M^2}{16} + M^2} = \frac{5M}{4}$

The third piece should also have the same momentum

Let its velocity be v, then

$\frac{5M}{4} = \frac{M}{2} \times v \Rightarrow v = \frac{5}{2} = 2.5\ m/sec$

153 **(b)**

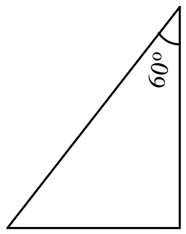
$l = \frac{1}{2} g \cos 60° \ t_1^2 \quad ....(i)$

$l\cos\theta = \frac{1}{2} g t_2^2 \quad ...(ii)$

$\frac{t_1^2}{t_2^2} = \frac{1}{\cos^2 60°}$

$= \frac{1}{4}$

$t_1 : t_2 = 2 : 1$



154 **(b)**

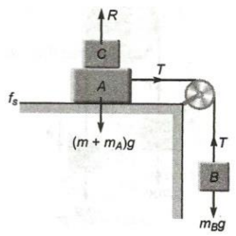
$T = 2\pi\sqrt{\frac{l}{g}}$ and $T' = 2\pi\sqrt{\frac{l}{4g/3}}$

[As $g' = g + a = g + \frac{g}{3} = \frac{4g}{3}$]

$\therefore T' = \frac{\sqrt{3}}{2} T$

155 **(a)**

The following free body diagram shows the various forces acting on the system. Let m be the minimum mass of block C and f_s be the maximum value of static friction.



For block A

$R = (m + m_A)g, f_s = T$

$\therefore \ \mu(m + m_A)g = T ...(i)$

For block B

$T = m_B g \quad ...(ii)$

From Eqs. (i) and (ii), we get

$m = \frac{m_B - \mu m_A}{\mu}$

$m = \frac{10 - 0.4 \times 15}{0.4} = 10$ kg

156 **(c)**

For upward acceleration apparent weight $= m(g + a)$

If lift suddenly stops during upward motion then apparent weight $= m(g - a)$ because instead of acceleration, we will consider retardation

In the problem it is given that scale reading initially was 60 kg and due to sudden jerk reading decreasing and finally comes back to the original mark $i.e.$, 60 kg

So, we can conclude that lift was moving upward with constant speed and suddenly stops

157 **(d)**

Here : Mass of ship $m = 2 \times 10^7 kg$,

Force $F = 25 \times 10^5 N$

Displacement $s = 25\ m$

According to the Newton's second law of motion

$F = ma$

$\Rightarrow a = \frac{F}{m} = \frac{25 \times 10^5}{2 \times 10^7} = 12.5 \times 10^{-2} m/s^2$

The relation for final velocity is

$v^2 = u^2 + 2as \ \Rightarrow v^2$

$= 0 + 2 \times (12.5 \times 10^{-2}) \times 25$

$\Rightarrow v = \sqrt{6.25} = 2.5\ m/s$

158 **(a)**

Work done against gravity $= mgh = 2 \times 10 \times 10 = 200\ J$

Work done against friction $=$ (Total work done $-$ work done against gravity) $= 300 - 200 = 100\ J$

159 **(c)**

$F_l = \mu_s R = 0.4 \times mg = 0.4 \times 10 = 4N$ $i.e.$ minimum $4N$ force is required to start the motion of a body. But applied force is only $3N$. So the block will not move

160 **(c)**

It works on the principle of conservation of momentum

161 **(b)**

Kinetic energy $= 10\ J$

$\Rightarrow \frac{1}{2} mv^2 = 10 \Rightarrow v^2 = 4$

From third equation of motion $v^2 = u^2 + 2as$

$4 = 0 + 2 \times a \times 2$

$\Rightarrow a = 1\ m/s^2$

$\because F_s = F - ma = 20 - 5 \times 1 = 15\ N$

162 **(c)**

$F_{\max} = 5 + 10 = 15N$ and $F_{\min} = 10 - 5 = 5\ N$

Range of resultant $5 \leq F \leq 15$

163 **(b)**

$F_k = \mu_k R = \mu_k mg \cos\theta$

$F_k = 1.7 \times 0.1 \times 10 \times \cos 30° = 1.7 \times \frac{\sqrt{3}}{2} N$

165 **(d)**

Work done by friction can be positive, negative

and zero depending upon the situation

166 **(a)**

$F_l \propto R \;\therefore F_l \propto m i.e.$ limiting friction depends upon the mass of body. So,

$\Rightarrow (F_l)' = \frac{3}{2} \times F_l = \frac{3}{2} \times 19.6 = 29.4\ N$

168 **(a)**

When friction absent

$a_1 = g \sin\theta$

$\therefore\ s_1 = \frac{1}{2} a_2 t_2^2 \quad \ldots.(\text{i})$

When friction in present

$a_2 = g \sin\theta - \mu_k g \cos\theta$

$\therefore\ s_2 = \frac{1}{2} a_2 t_2^2 \quad \ldots.(\text{ii})$

From Eqs. (i) and (ii), we have

$\frac{1}{2} a_1 t_1^2 = \frac{1}{2} a_2 t_2^2$

or $a_1 t_1^2 = a_2 (n t_1)^2 \quad (\because\ t_2 = n t_2)$

or $a_1 = n^2 a_2$

or $\frac{a_2}{a_1} = \frac{g \sin\theta - \mu_k g \cos\theta}{g \sin\theta} = \frac{1}{n^2}$

or $\frac{g \sin 45° - \mu_k g \cos 45°}{g \sin 45°} = \frac{1}{n^2}$

or $1 - \mu_k = \frac{1}{n^2}$

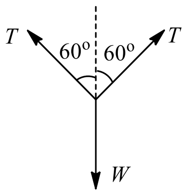
or $\mu_k = 1 - \frac{1}{n^2}$

169 **(c)**

$5\text{g} - T_2 = 5a$....(i)

$T_2 - T_1 - 3g = 3a$...(ii)

$T_1 - \text{g} = a$...(iii)

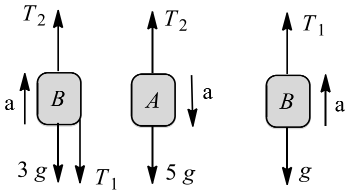


Adding Eqs (i) and (iii),

$-T_2 + T_1 + 4\text{g} = 6a$

Adding this to Eq. (ii), we get

$g = 9a$ or $a = \frac{\text{g}}{9}$



170 **(d)**

$T = m\text{g} + ma$

$2000\text{g} = 1000\text{g} + 1000a$

or $a = \text{g}$

Direction is upward

Now, $0^2 - 2.5^2 = -2 \times 10 \times \text{s}$

or $\text{s} = \frac{2.5 \times 2.5}{20}$

$= \frac{625}{100 \times 20} = \frac{25}{80}\text{m} = \frac{5}{16}\text{m}$

171 **(b)**

The acceleration of the centre of mass of the block,

$= \frac{g}{2}\sqrt{(\sin\angle ABC)^2 + (\sin\angle ABC)^2}$

$= \frac{g}{2}\sqrt{\sin^2 30° + \sin^2 60°}$

$= \frac{g}{2}\sqrt{(0.5)^2 + (0.866)^2} = \frac{g}{2}$

172 **(a)**

$\mu = \tan\theta\left(1 - \frac{1}{n^2}\right) = 1 - \frac{1}{n^2} \quad [\text{As}\theta = 45°]$

173 **(c)**

Minimum force required to move a body up a rough inclined plane

$F_1 = mg(\sin\theta + \mu\cos\theta)$

Minimum force required to prevent the body from sliding down the rough inclined plane.

$F_2 = \mu\, mg \cos\theta$

According to question

$F_1 = 3\,F_2$

$\therefore\ mg(\sin\theta + \mu\cos\theta) = 3(\mu\, mg\cos\theta)$

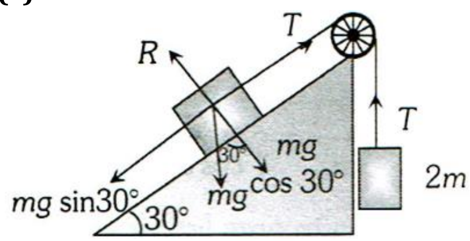
$\sin\theta + \mu\cos\theta = 3\mu\cos\theta$

$\sin\theta = 2\mu\cos\theta$

$\tan\theta = 2\mu = 2 \times \frac{1}{2\sqrt{3}} = \frac{1}{\sqrt{3}} = \tan 30°$

$\theta = 30°$

174 **(c)**



$2mg - T = 2ma \quad$ ...(i)

$T - mg\sin 30° = ma \quad$ ...(ii)

(i) + (ii) gives,

$2mg - \frac{mg}{2} = 3ma \Rightarrow a = \frac{g}{2}$

175 **(b)**

The acceleration of a rocket is given by

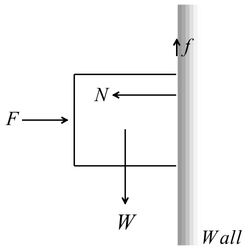
$a = \frac{v}{m}\left(\frac{\Delta m}{\Delta t}\right) - g$

$= \frac{400}{100}\left[\frac{5}{1}\right] - 10$

$= 20 - 10 = 10\ \text{m/s}^2$

176 **(d)**

The various forces acting on the book are as shown in the figure



Where, $f =$ Frictional force
$W =$ Weight of a book
$F =$ Applied force
$N =$ Normal reaction
From figure,
The direction of force of friction between the wall and the book is upwards

177 **(b)**
Impulse is given by the product of force and time.
Form Newton's second law

$F = ma = m\dfrac{\Delta v}{\Delta t}$

$\Rightarrow F\Delta t = m\Delta v$

$=$ change in the momentum of the body.

178 **(d)**
Angular momentum is an axial vector, so its direction is along the axis, perpendicular to the plane of motion which is not changing because of change of speed. Therefore, the direction of angular momentum remains the same and its magnitude may vary

179 **(c)**
The value measured by O_1 in $N_1 = mg$ because acceleration of body with respect to O_1 is zero
The value measured by O_2 is

$N_2 - mg = ma_0$

$\therefore\ N_2 = m(g + a_0)$

So, $N_1 \neq N_2$

180 **(a)**

$ma = mg\sin\theta - f$

or $f = mg\sin\theta - ma$

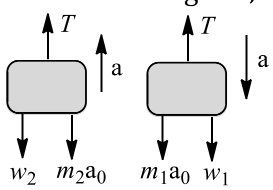
$= 8\left[10 \times \frac{1}{2} - 0.4\right]$ N $= 8\times 4.6$N $= 36.8$ N

181 **(a)**
For solving the problem, we assume that observer is situated in the frame of pulley (non-inertial reference frame)

$m_1 g = w_1$

$m_2 g = w_2$

From force diagram,



$T - m_2 a_0 - w_2 = m_2 a$

or $T - m_2 g - w_2 = m_2 a \quad (\because a_0 = g)$

or $T - 2w_2 = m_2 a$...(i)

From force diagram,

$m_1 a_0 + w_1 - T = m_1 a$

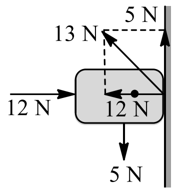
or $m_1 a_0 + w_1 - T = m_1 a$

or $2w_1 - T = m_1 a$...(ii) $(\because a_0 = g)$

From Eqs. (i) and (ii),

$T = \dfrac{4w_1 w_2}{w_1 + w_2}$

182 **(d)**
Wall applies 2 forces of the block (i) normal reaction, $R = 12$ N, and (ii) frictional force, $f_2 = mg = 5$ N tangentially upward



$\therefore$ Total force exerted by wall on block

$F = \sqrt{N^2 + f_s^2} = \sqrt{(12)^2 + (5)^2} = 13$N

183 **(a)**
Weight of the disc will be balanced by the force applied by the bullet on the disc in vertically upward direction

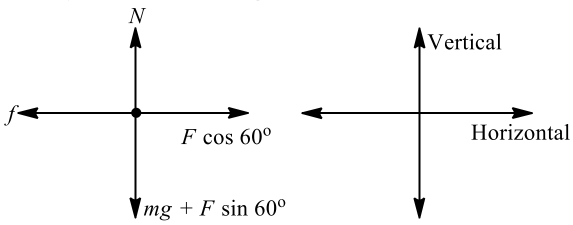
$F = nmv$

$= 40 \times 0.05 \times 6 = Mg$

$M = \dfrac{40 \times 0.05 \times 6}{16}$

$= 1.2$ kg

184 **(a)**
Free body diagram (FBD) of the block (shown by a dot) is shown in figure.



For vertical equilibrium of the block,

$N = mg + F\sin 60° = \sqrt{3}\,g + \sqrt{3}\dfrac{F}{2}$ ....(i)

For no motion, force of friction

$f \geq F\cos 60°$

or °$\mu N \geq F\cos 60°$

or $\dfrac{1}{2\sqrt{3}}\left(\sqrt{3}g + \dfrac{\sqrt{3}F}{2}\right) \geq \dfrac{F}{2}$

or $g \geq \dfrac{F}{2}$ or $F \leq 2\,g$ or 20 N

Therefore, maximum value of F is 20 N.

185 **(d)**

$\frac{dm}{dt} = 0.1\ kg$ / sec; Mass of the rocket = $100\ kg$

$v = 1\ km/\text{sec} = 1000\ m/\text{sec}$

$F = \frac{d(mv)}{dt} = m\frac{dv}{dt} - v\frac{dm}{dt} = 0$ as the mass is decreasing

$100a - 1000 \times 0.1 = 0$

$a = +1\ m/s^2$

186 **(a)**

The correct surface profile will be (a), because slope of surface should change from one constant value (non-zero) in terms of sign because force is constant picewise.

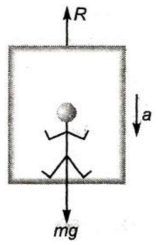
187 **(d)**

When lift falls with acceleration (a)or rises with retardation $(-a)$, then a person apparently loses weight.

$R - mg = -ma$

$\Rightarrow R = m(g-a)$

In the given case scale reading changes from 60 kg to 50 kg for a while and then comes back to 60 kg mark. It happens while the lift in motion upwards suddenly stops.



188 **(a)**

If A is climbing with constant velocity, then

$T' = 5\text{g} + T$ and $T = 2\text{g}$

$T' = 5\text{g} + 2\text{g} = 7\text{g} = 7 \times 10\text{N} = 70\text{N}$

Suppose A is climbing with acceleration a such that $T = 30$ N

That $T = 30$ N

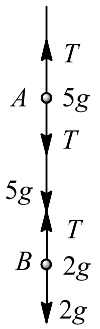
$T - 2a = 2a$

$30 - 2 \times 10 = 2a$

or $a = 5\ \text{ms}^{-2}$

Again, $T' - T - 5\text{g} = 5a$ or $T' = T + 5\text{g} + 5a$

or $T' = (30 + 50 + 25)$ N= 105 N



189 **(b)**

When the lift is moving upward with constant velocity then,

$R = mg \ \therefore F = \mu R = \mu mg$

190 **(a)**

Retardation of train $= \frac{36\ \text{kmh}^{-1}}{5\ s}$

$= \frac{35 \times \frac{5}{18}\text{ms}^{-1}}{5s} = 2\ \text{ms}^{-2}$

It acts in the backward direction

Fictitious force on suitcase $= 2m$ N,

Where m is the mass of suitcase

It acts in the forward direction

Due to this force, the suitcase has a tendency to slide forward. If suitcase is not to slide, then $2m =$ force f of friction

or $2m = \mu m\text{g}$ or $\mu = \frac{2}{\text{g}} = \frac{2}{9.8} = \frac{20}{98} = \frac{10}{49}$

191 **(d)**

The stopping distance, $S \propto u^2 (\because v^2 = u^2 - 2as)$

$\Rightarrow \frac{S_2}{S_1} = \left(\frac{u_2}{u_1}\right)^2 = \left(\frac{120}{60}\right)^2 = 4$

$\Rightarrow S_2 = 4 \times S_1 = 4 \times 20 = 80\ m$

192 **(c)**

The limiting force of friction is

$f_s = 10\ N$

As $F = 8N < f_s$,therefore, block does not move.

As static friction is a self adjusting force, therefore the frictional force on the block is 8 N

193 **(a)**

For limiting condition $\mu = \frac{m_B}{m_A + m_C} \Rightarrow 0.2 = \frac{5}{10 + m_C}$

$\Rightarrow 2 + 0.2m_C = 5 \Rightarrow m_C = 15\ kg$

194 **(c)**

Resultant force,

$F = \sqrt{F_1^2 + F_2^2 + 2F_1F_2\cos\theta}$

$= \sqrt{(3)^2 + (4)^2 + 2 \times 3 \times 4\cos 90°}$

$= 5$ N

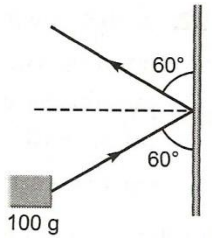
195 **(b)**

Spring balance reading in terms of kgf

$= \frac{4m_1m_2}{m_1 + m_2} = \frac{4 \times 5 \times 1}{6} = \frac{10}{3}$

This is less than 6 kgf

196 **(a)**



Change in the velocity $= v \sin \theta - (-v \sin \theta) =$
$2 \sin \theta$

Change in the momentum

$\Delta p = 2\, mv \sin \theta$

$\therefore$ Force applied $F = \frac{\Delta p}{\Delta t}$

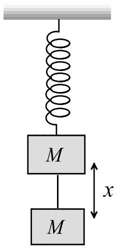
$= \frac{2 \times 100 \times 10^{-3} \times 5 \sin \theta\, 60°}{2 \times 10^{-3}}$

$= 100 \times 5 \times \frac{\sqrt{3}}{2}$

$= 250\sqrt{3}$ N (To the right)

197 **(b)**

Work done in max extension = stored $P.E.$



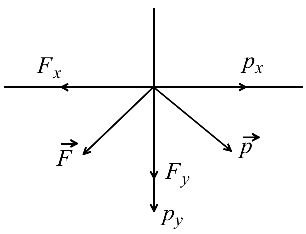
$\Rightarrow Mg \times x = \frac{1}{2} kx^2$

$\Rightarrow x = \frac{2Mg}{k}$

198 **(d)**

$\vec{p}(t) = A(\hat{\imath} \cos kt - \hat{\jmath} \sin kt)$

$\vec{F} = \frac{d}{dt}\left(\vec{p}(t)\right) = Ak(-\hat{\imath} \sin kt - \hat{\jmath} \cos kt)$



$\vec{F}.\vec{p} = A^2 k(-\cos kt \sin kt + \sin kt \cos kt) = 0$

$\therefore$ The momentum and force are perpendicular to each other at 90°

199 **(c)**

$F = v\frac{dm}{dt} = 10 \times 5 \text{ N} = 50 \text{ N}$

200 **(c)**

Let coefficient of friction is μ, and then retardation will be μg.

From equation of motion, $v = u + at$

$\Longrightarrow \quad 0 = 6 - \mu\, g \times 10$

$\Longrightarrow \mu = \frac{6}{100} = 0.06$

201 **(d)**

Applying the law of conservation of linear momentum, we get

$0.5 \times v = \sqrt{(2 \times 8)^2 + (1 \times 12)^2} = \sqrt{256 + 144}$

$= \sqrt{400}$

$0.5\, v = 20 \Rightarrow v = \frac{20}{0.5} = 40\ ms^{-1}$

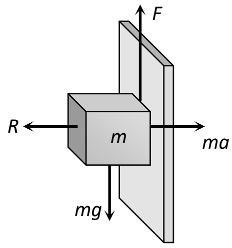
202 **(c)**

Impulse = Force × Time $= 50 \times 10^{-5} \times 3$

$= 1.5 \times 10^{-3} N\text{-}s$

203 **(a)**

For the limiting condition upward friction force between board and block will balance the weight of the block



$i.e. F > mg$

$\Rightarrow \mu(R) > mg$

$\Rightarrow \mu(ma) > mg$

$\Rightarrow \mu > \frac{g}{a}$

204 **(b)**

Resultant force $F_{\text{net}} = \sqrt{F_1^2 + F_2^2 + 2F_1F_2 \cos \theta}$

$= \sqrt{(10)^2 + (10)^2 + 2 \times 10 \times 10 \times \cos 60°}$

$= \sqrt{100 + 100 + 100} = 10\sqrt{3}$

Mass of the body =10 kg

$\therefore$ Acceleration $= \frac{\text{force}}{\text{mass}}$

$= \frac{10\sqrt{3}}{10} = \sqrt{3}\text{ms}^{-2}$

205 **(a)**

$\Delta P = p_i - p_f = mv - (-mv) = 2\, mv$

206 **(c)**

$m\frac{dv}{dt} = F_0 e^{-bt} \Rightarrow \frac{dv}{dt} = \frac{F_0}{m} e^{-bt}$

$\Rightarrow \int_0^v dv = \frac{F_0}{m} \int_0^t e^{-bt} dt$

$\Rightarrow v = \frac{F_0}{m} \left[\frac{e^{-bt}}{-b}\right]_0^t$

$\Rightarrow v = \frac{F_0}{mb}(1 - e^{-bt})$

207 **(d)**

$f_{ms} = 0.6 \times 10 \times 9.8$ N

$= 58.8$ N

Since the applied force is greater than f_{ms} therefore the block will be in motion. So, we

should consider f_k

$f_k = 0.4 \times 10 \times 9.8$ N or $f_k = 4 \times 9.8$ N

This would cause acceleration of 40 kg block

Acceleration $= \frac{4\times9.8 \text{ N}}{40 \text{ kg}} = 0.98 \text{ ms}^{-2}$

208 **(d)**

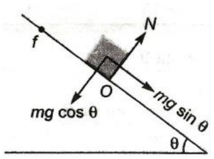
Condition of sliding is

$mg \sin\theta > \mu mg \cos\theta$

or $\tan\theta > \mu$

or $\tan\theta > \sqrt{3}$ ...(i)

condition of toppling is



Torque of $mg \sin\theta$about $O >$ torque of $mg \cos\theta$about.

$$\therefore \quad (mg\sin\theta)\left(\frac{15}{2}\right) > (mg\cos\theta)\left(\frac{10}{2}\right)$$

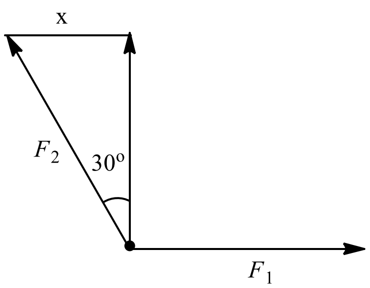
or $\tan\theta > \frac{2}{3}$ .... (ii)

With increase in value of θ, condition of sliding is satisfied first.

210 **(a)**

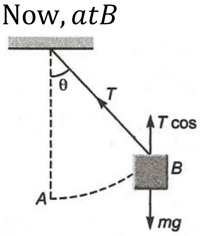
$$\tan 30° = \frac{1}{\sqrt{3}} = \frac{x}{10}$$

$$x = \frac{10}{\sqrt{3}}$$



211 **(b)**

Now, atB



In equilibrium,

$T\cos\theta = mg$

$$\Rightarrow \cos\theta = \frac{150 \times 9.8}{2940}$$

$\Rightarrow \cos\theta = 0.5 \Rightarrow \theta = 60°$

212 **(c)**

Distance travelled in t^{th} second is,

$$s_t = u + at - \frac{1}{2}a$$

Given, $u = 0$

$$\therefore \quad \frac{s_n}{s_n + 1} = \frac{an - \frac{1}{2}a}{a(n+1) - \frac{1}{2}a} = \frac{2n-1}{2n+1x}$$

213 **(a)**

When

$P = mg\ (\sin\theta - \mu\cos\theta)$

$f = \mu mg \cos\theta$(upwards)

when $P = mg\sin\theta$

$f = 0$

and when $P = mg(\sin\theta + \mu\cos\theta)$

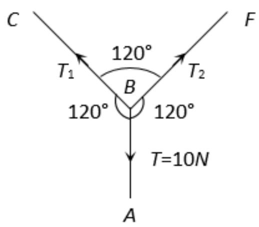
$f = \mu\, mg \cos\theta$ (downwards)

Hence, friction is first positive, then zero and then negative.

214 **(c)**

By drawing the free body diagram of point B

Let the tension in the section BC and BF are T_1 and T_2 respectively



From Lami's theorem

$$\frac{T_1}{\sin 120°} = \frac{T_2}{\sin 120°} = \frac{T}{\sin 120°}$$

$\Rightarrow T = T_1 = T_2 = 10\ N$

215 **(c)**

If man slides down with some acceleration, then its apparent weight decreases. For critical condition rope can bear only 2/3 of his weight. If a is the minimum acceleration, then tension in the rope= $m(g - a)$ breaking strength

$$\Rightarrow m(g-a) = \frac{2}{3}mg$$

$$\Rightarrow a = g - \frac{2g}{3} = \frac{g}{3}$$

216 **(d)**

Pseudo force on the block $= m \times 4$ N (backward)

Force of friction $= 0.4 \times m \times 10$ N (forward)

Equating , $m \times 4 = 0.4 \times m \times 10 = 4m$

Clearly the equation holds good for all values of m

217 **(a)**

The bullets are initially at rest

Change of momentum per second $= mvN$

Where N is the number of bullets fired per second

218 **(d)**

$$T = (M + m)(g + a) = (940 + 60)(10 + 1) = 11000\ N$$

219 **(d)**

For moving on circular path without slipping, centripetal force must equal frictional force

That is,

$$\frac{mv^2}{r} = \mu mg$$

$$\Rightarrow mr\omega^2 = \mu mg [\because v = r\omega]$$

$$\Rightarrow r\omega^2 = \mu g$$

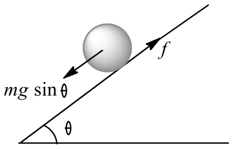
$$\therefore \omega = \sqrt{\frac{\mu g}{r}} = \sqrt{\frac{0.5 \times 9.8}{10}} = 0.7\ rad/s$$

220 **(a)**

For equilibrium of forces, the resultant of two (smaller) forces should be equal and opposite to third one

221 **(a)**

As shown in figure, component of weight ($mg \sin \theta$) is always down the inclined plane, whether the cylinder is following up or it is rolling down. Therefore, for no slipping, sense of angular acceleration must be the same in both the cases. Therefore, force of friction (f) acts up the inclined plane in both the cases



222 **(c)**

Initially due to upward acceleration apparent weight of the body increases but then it decreases due to decrease in gravity

223 **(a)**

$$\text{Acceleration, } a = \frac{M_1 - M_2}{M_1 + M_2} g$$

$$= \frac{M - \frac{M}{2}}{M + \frac{M}{2}} g = \frac{\frac{M}{2}}{\frac{3M}{2}} g = \frac{g}{3}$$

224 **(c)**

$$\text{Acceleration of the car} = \frac{\text{Force on the car}}{\text{Mass of the car}}$$

$$= \frac{mnv}{M} = \frac{0.01 \times 10 \times 500}{2000} \text{ms}^{-2} = \frac{5}{200} \text{ms}^{-2} = \frac{1}{40} \text{ms}^{-2}$$

225 **(b)**

Since downward force along the inclined plane $= mg \sin \theta = 5 \times 10 \times \sin 30° = 25N$

226 **(c)**

As external force is zero

$$m_1 v_1 + m_2 v_2 = 0$$

$$v_2 = \frac{-m_1 v_1}{m_2} = -\frac{60 \times 0.4}{30} = -0.8\ \text{ms}^{-1}$$

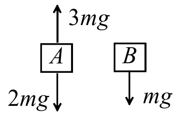
It means that boy moves with speed $0.8\ \text{ms}^{-1}$ opposite to velocity of man.

So, relative velocity of man and boy is

$$v_r = 0.8 + 0.4 = 1.2\ \text{ms}^{-1}$$

Hence, separation $d = v_r t = 1.2 \times 5 = 6\text{m}$

227 **(b)**



$$a_A = g/2$$

$$a_B = g$$

228 **(c)**

As $m_1 : m_2 : m_3 = 1 : 1 : 3$

and momentum is conserved,

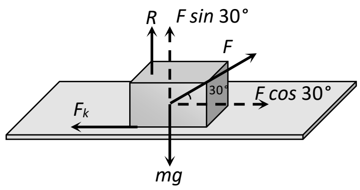
$$\therefore \sqrt{p_1^2 + p_2^2 + p_3^2} = 3v_3$$

$$\sqrt{1 \times 39^2 + 1 \times 39^2} = 3v_3$$

$$39\sqrt{2} = 3v_3$$

$$v_3 = \frac{39\sqrt{2}}{3} = 13\sqrt{2}\text{ms}^{-1}$$

229 **(a)**



$$\text{Kinetic friction} = \mu_k R = 0.2(mg - F \sin 30°)$$

$$= 0.2\left(5 \times 10 - 40 \times \frac{1}{2}\right) = 0.2(50 - 20) = 6N$$

$$\text{Acceleration of the block} = \frac{F \cos 30° - \text{Kinetic friction}}{\text{mass}}$$

$$= \frac{40 \times \frac{\sqrt{3}}{2} - 6}{5} = 5.73\ m/s^2$$

230 **(c)**

Maximum force by surface when friction works

$$F = \sqrt{f^2 + R^2} = \sqrt{(\mu R)^2 + R^2} = R\sqrt{\mu^2 + 1}$$

Minimum force $= R$ where there is no friction

Hence ranging from R to $R\sqrt{\mu^2 + 1}$

We get, $Mg \le F \le Mg\sqrt{\mu^2 + 1}$

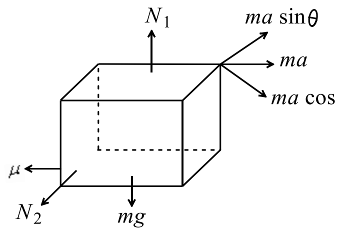
231 **(a)**

Slope of surface should change from one constant value (non zero) to another constant value (non zero) in terms of sign because force is constant piecewise

232 **(a)**

Making FBD of block with respect to disc

Let A be the acceleration of block with respect to disc



$N_1 = mg$

$N_2 = ma\sin\theta$

$$A = \frac{ma\cos\theta - \mu N_2 - \mu N_1}{m} = 10 m/s^2$$

233 **(d)**

$R = m(g-a) = m(10-10)$ =zero

234 **(b)**

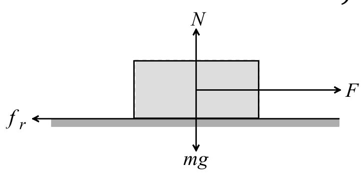
Tension is rope, $T <$ Breaking load, $\frac{2}{3}mg$

$\therefore m(g-a) < \frac{2}{3}mg$ or $a > \frac{g}{3}$

235 **(a)**

$F = f_r = \mu N = \mu mg = 0.1 \times 1 \times 9.8 = 0.98\ N$

(Assuming that the value of $\mu = 0.1$ is the coefficient of static friction)



236 **(d)**

$$T = \frac{2 \times m_B m_C}{m_A + m_B + m_C} \times g = \frac{2 \times 1 \times 5}{3+1+5} \times g = \frac{10}{9} g$$

238 **(c)**

Thrust $F = u\left(\frac{dm}{dt}\right) = 5 \times 10^4 \times 40 = 2 \times 10^6 N$

239 **(b)**

Opposite force causes retardation

240 **(d)**

Time taken by the bullet and ball to strike the ground is

$$t = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 5}{10}} = 1\ \text{s}$$

Let v_1 and v_2 are the velocities of ball and bullet after collision. Then applying

$x = vt$

We have, $20 = v_1 \times 1$

or $v_1 = 20$ m/s

$100 = v_2 \times 1$ or $v_2 = 100$ m/s

Now, from conservation of linear momentum before and after collision we have,

$0.01v = (0.2 \times 20) + (0.01 \times 100)$

On solving, we get

$v = 500$ m/s

241 **(c)**

$v_1 = 10\ m/s$; $m_1 = 10\ kg$

$v_2 = 0$; $m_2 = 9\ kg$

$v_3 = v$; $m_3 = 1\ kg$

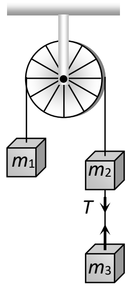
According to conservation of momentum

$m_1 v_1 = m_2 v_2 + m_3 v_3$

$10 \times 10 = 9 \times 0 + 1 \times v; v = 100\ m/s$

242 **(b)**

Tension between m_2 and m_3 is given by



$$T = \frac{2m_1 m_3}{m_1 + m_2 + m_3} \times g$$

$$= \frac{2 \times 2 \times 2}{2+2+2} \times 9.8 = 13\ N$$

243 **(a)**

$$m = \frac{F}{a} = \frac{\sqrt{6^2 + 8^2 + 10^2}}{1} = \sqrt{200} = 10\sqrt{2} kg$$

244 **(b)**

Angular frequency of the system,

$$\omega = \sqrt{\frac{k}{m+m}} = \sqrt{\frac{k}{2m}}$$

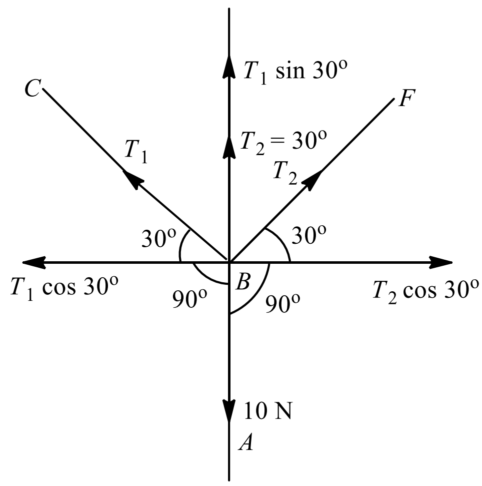
Maximum acceleration of the system will be, $\omega^2 A$ or $\frac{kA}{2m}$. This acceleration to the lower block is provided by friction.

Hence, $f_{\max} = ma_{\max}$

$$= m\omega^2 A = m\left(\frac{kA}{2m}\right) = \frac{kA}{2}$$

245 **(c)**

From the figure,



$T_1 \cos 30° = T_2 \cos 30°$

$\therefore\ T_1 = T_2 = T$(Let)

Again, $T_1 \sin 30° + T_2 \sin 30° = 10$

$2T \sin 30° = 10$

$2T\frac{1}{2} = 10 \quad \Rightarrow T = 10$ N

$\therefore$ Tension in section BC and BF are 10 N and 10 N.

246 **(d)**

Particle will move with uniform velocity due to inertia

247 **(a)**

$F = u\left(\frac{dm}{dt}\right)$

$= 20 \times \frac{50}{60}$

$= 16.66$ N

248 **(b)**

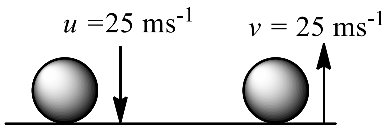
If a large force F acts for a short time dt the impulse imparted I is

$I = F.dt, = \frac{dp}{dt}.dt$

$I = dp =$change in momentum

249 **(a)**

Mass of ball $m = 1.5$ kg



Speed of ball at the time of hitting,

$u = 25\ \text{ms}^{-1}$

Speed of ball while rebounding

$v = 15\ \text{ms}^{-1}$

Duration of contact with floor $t = 0.03$ s

Let force exerted by the ball on floor $= F$

Applying Newton's II law of motion

$F = \frac{\Delta p}{\Delta t}$

$F = \frac{mv - mu}{t} = \frac{1.5 \times 15 \times (-25)}{0.03}$

$= \frac{1.5(15 + 25)}{0.03} = 50 \times 40N$

$F = 2000$ N

250 **(b)**

Here, mass of bullet $m = 10g = \frac{10}{1000}kg$

Mass of ice, $M = 5kg$

According to the conservation of linear momentum, we get

$m \times 300 + M \times 0 = m \times 0 + mv$

$\Rightarrow \frac{10}{1000} \times 300 + M \times 0 = 5v$

$\therefore v = \frac{3}{5} = 0.6\ m/s = 60\ cm/s$

251 **(c)**

Two masses are moving with equal kinetic energy.

$\frac{1}{2}Mv_1^2 = \frac{1}{2}4Mv_2^2$

or $\frac{v_1}{v_2} = 2$

The ratio of linear momentum is

$\frac{p_1}{p_2} = \frac{Mv_1}{4Mv_2}$

or $\frac{p_1}{p_2} = \frac{1}{4}\left(\frac{v_1}{v_2}\right)$

or $\frac{p_1}{p_2} = \frac{2}{4} = \frac{1}{2}$

or $p_1 : p_2 = 1:2$

252 **(c)**

Gas will come out with sufficient speed in forward direction, so reaction of this forward force will change the reading of the spring balance

253 **(a)**

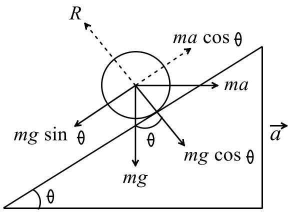
Relative vertical acceleration of A with respect to B

$= g(\sin^2 60° - \sin^2 30°)$

$= 9.8\left(\frac{3}{4} - \frac{1}{4}\right) = 4.9\ m/s^2$

254 **(c)**

Here, $\sin\theta = \frac{1}{l}$



Let required acceleration of inclined plane to be a for the object to remain stationary relative to incline, we have

$ma\cos\theta = mg\sin\theta$

$a = g\tan\theta = g\frac{1}{\sqrt{l^2 - 1}}$

255 **(d)**

$F_1 = mg(\sin\theta + \mu\cos\theta)$

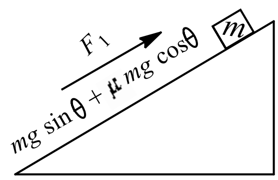
$F_2 = mg(\sin\theta + \mu\cos\theta)$

$\frac{F_1}{F_2} = \frac{\sin\theta + \mu\cos\theta}{\sin\theta - \mu\cos\theta}$

$= \frac{\tan\theta + \mu}{\tan\theta - \mu}$

$= \frac{2\mu + \mu}{2\mu - \mu}$

$= 3$



256 **(d)**

If the applied force is less than limiting friction between block A and B , then whole system move with common acceleration

$i.e. a_A = a_B = \dfrac{F}{m_A + m_B}$

but the applied force increases with time, so when it becomes more than limiting friction between A and B, block B starts moving under the effect of net force $F - F_k$ Where F_k = kinetic friction between block A and B

$\therefore$ Acceleration of block B, $a_B = \frac{F-F_k}{m_B}$

As F is increasing with time so a_B will increase with time

Kinetic friction is the cause of motion of block A

$\therefore$ Acceleration of block A, $a_A = \frac{F_k}{m_A}$

It is clear that $a_B > a_A$. $i.e.$ graph (d) correctly represents the variation in acceleration with time for block A and B

257 **(b)**

Horizontal velocity of apple will ren ain same but due to retardation of train, velocity of train and hence velocity of boy $w.r.t.$ ground decreases, so apple falls away from the hand of boy in the direction of motion of the train

258 **(d)**

Gravitational field is a conservative field. Therefore work done in moving a particle from A to B is independent of path chosen

259 **(b)**

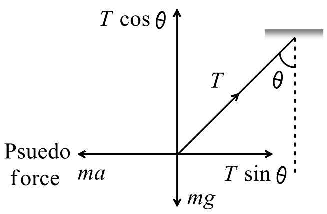
Surfaces always slide over each other

260 **(a)**

$T\cos\theta = mg$

$T\sin\theta = ma$

$\tan\theta = \dfrac{a}{g}$



$\therefore \theta = \tan^{-1}(a/g)$

261 **(b)**

When the lift is stationary $W = mg$

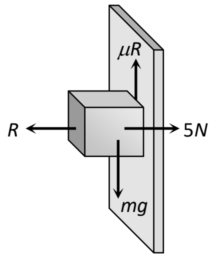
$\Rightarrow 49 = m \times 9.8 \Rightarrow m = 5\ kg$

When the lift is moving downward with an acceleration

$R = m(9.8 - a) = 5[9.8 - 5] = 24\ N$

262 **(b)**

Limiting friction $F_1 = \mu_s R = 0.5 \times (5) = 2.5\ N$



Since downward force is less than limiting friction therefore block is at rest so the static force of friction will work on it

F_s = downward force = Weight

$= 0.1 \times 9.8 = 0.98\ N$

263 **(d)**

Weight of the body $= 64\ N$

So mass of the body $m = 6.4\ kg, \mu_s = 0.6, \mu_k = 0.4$

Net acceleration $= \frac{\text{Applied force}-\text{Kinetic friction}}{\text{Mass of the body}}$

$= \dfrac{\mu_s mg - \mu_k mg}{m} = (\mu_s - \mu_k)g = (0.6 - 0.4)g$

$= 0.2g$

264 **(d)**

The effective acceleration of ball observed by observer on earth $= (a - a_0)$

As $a_0 < a$, hence net acceleration is in downward direction

266 **(c)**

If monkey move downward with acceleration a then its apparent weight decreases. In that condition

Tension in string $= m(g - a)$

This should not be exceed over breaking strength of the rope $i.e.$ $360 \geq m(g - a) \Rightarrow 360 \geq 60(10 - a) \Rightarrow a \geq 4\ m/s^2$

267 **(c)**

Here B is implying A but A is not implying B, as kinetic energy of system of particles is zero means speed of each and every particles is zero, which says the momentum of every particle is zero. But statement A means linear momentum of system of particle is zero, which may the true even if particles have equal and opposite momentums and hence, having non-zero KE.

268 **(d)**

From conservation of momentum

$MV + (4mv) = 0$

$\Rightarrow V = -\dfrac{4mv}{M}$

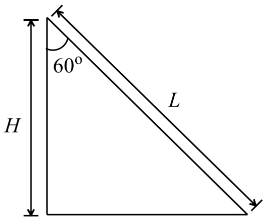
$= -\dfrac{4 \times 35 \times 10^{-3} \times 400}{20}$

$= -2.8\ \text{ms}^{-1}$

Force applied on the rifle,

$$F = \frac{MV}{t} = -\frac{20 \times 2.8}{1} = -56 \text{ N}$$

271 **(b)**



Let L be the length and H be height of the inclined plane respectively

Acceleration of the block slide down the smooth incline plane is

$a = g\cos 60°$

$\therefore L = \frac{1}{2} g \cos 60°\, t_1^2 \quad [\because u = 0] \quad ...(\text{i})$

Acceleration of another block dropped vertically down from the same inclined plane is

$a = g$

$$\therefore H = \frac{1}{2}at_2^2 = \frac{1}{2}gt_2^2 [\because u = 0]$$

From figure,

$$\cos 60° = \frac{H}{L} \Rightarrow H = L\cos 60°$$

$\therefore L\cos 60° = \frac{1}{2}gt_2^2 \quad ...(\text{ii})$

Divide (i) by (ii), we get

$$\frac{t_1^2 \cos 60°}{t_2^2} = \frac{1}{\cos 60°}$$

$$\frac{t_1^2}{t_2^2} = \frac{1}{\cos^2 60°} = \frac{4}{1} \Rightarrow \frac{t_1}{t_2} = \frac{2}{1}$$

273 **(d)**

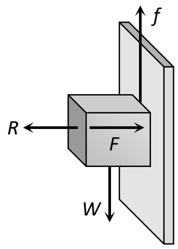
$K = \frac{F}{x}$ and increment in length is proportional the original length $i.e. x \propto l \ \therefore K \propto \frac{1}{l}$

It means graph between K and l should be hyperbolic in nature

274 **(c)**

Here applied horizontal force F acts as normal reaction. For holding the block

Force of friction = Weight of block



$f = W \Rightarrow \mu R = W$

$\Rightarrow \mu F = W$

$$\Rightarrow F = \frac{W}{\mu}$$

As $\mu < 1 \ \therefore F > W$

275 **(a)**

Block B will come to rest, it force applied to it will vanish due to frictional force acting between block B and surface ie,

force applied = frictional force

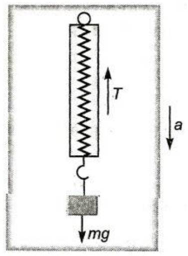
$ie, \quad \mu mg = ma$

$$\text{or}\ \mu mg = m\left(\frac{v}{t}\right)$$

$$\text{or } t = \frac{v}{\mu g}$$

277 **(a)**

In stationary position,



Spring balancing reading

$= mg = 49$

$$m = \frac{49}{9.8} = 5\text{kg}$$

When lift moves downward,

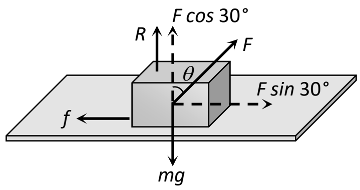
$mg - T = ma$

Reading of balance

$T = mg - ma$

$= 5(9.8 - 5) = 5 \times 4.8 = 24.0 \text{ N}$

278 **(d)**



For limiting condition $f = \mu R$

$F \sin 30° = \mu(mg - F\cos\ 30°)$,

By solving, $F = 294.3\ N$

279 **(c)**

Acceleration $= \frac{(m_2 - m_1)}{(m_2 + m_1)} g$

$$= \frac{4-3}{4+3} \times 9.8 = \frac{9.8}{7} = 1.4\ m/\text{sec}^2$$

280 **(c)**

Distance travelled by the body in n^{th} second is given by

$$S_n = u + \frac{a}{2}(2n - 1)$$

$$5 = u + \frac{a}{2}(2 \times 1 - 1)$$

$$5 = u + \frac{a}{2} \quad .....(\text{i})$$

$$2 = u + \frac{a}{2}(2 \times 3 - 1)$$

$$2 = u + \frac{5}{2}a \ldots . \text{(ii)}$$

Solving Eqs. (i) and (ii), we get

$$a = -\frac{6}{4}\text{ms}^{-2}$$

ie, body is decelerating

Given, mass = 4kg

$$\therefore F = m \times a = 4 \times \frac{6}{4} = 6 \text{ N}$$

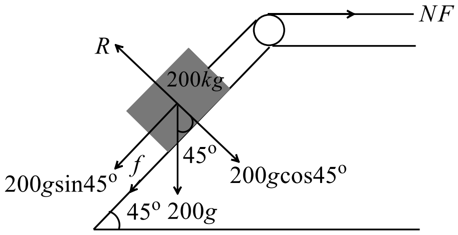
281 **(a)**

$$S_{\text{Horizontal}} = ut = 1.5 \times 4 = 6m$$

$$S_{\text{Vertical}} = \frac{1}{2}at^2 = \frac{1}{2}\frac{F}{m}t^2 = \frac{1}{2} \times 1 \times 16 = 8\ m$$

$$S_{\text{Net}} = \sqrt{6^2 + 8^2} = 10\ m$$

283 **(c)**



Here, mass of the block, $m = 200\ kg$

Coefficient of static friction, $\mu_s = 0.5 = \frac{1}{2}$

Angle of incline plane, $\theta = 45°$

Maximum force that each man can apply, $F = 500\ N$

Let N number of man are required for the block to just start moving up the plane $NF = mg\sin\theta + f$

$= mg\sin\theta + \mu_s R$

$= mg\sin\theta + \mu_s mg\cos\theta = mg\,[\sin\theta + \mu_s\cos\theta]$

$$= 200 \times 10\left[\sin 45° + \frac{1}{2}\cos 45°\right]$$

$$= 200 \times 10\left[\frac{1}{\sqrt{2}} + \frac{1}{2\sqrt{2}}\right] = \frac{200 \times 10 \times 3}{2\sqrt{2}}$$

$$\therefore N = \frac{200 \times 10 \times 3}{2\sqrt{2} \times 500} = 5$$

284 **(d)**

$$F = mnv = 150 \times 10^{-3} \times 20 \times 800 = 2400\ N$$

285 **(d)**

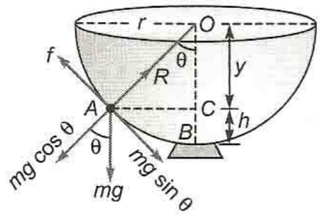
Special theory of relativity is based on two postulates

(i) All laws of physics are the same in all inertial reference frames

(ii) The speed of light in vacuum has the same value in all inertial frames, regardless of the velocity of the observer or the velocity of source emitting the light

286 **(a)**

In figure O is the centre of the bowl of radius r. The insect will crawl (from B to A) till component of its weight (mg) along the bowl is balanced by the force of limiting friction (f)



$$ie, mg\sin\theta = f = \mu R = \mu mg\cos\theta$$

or $\mu = \tan\theta = \frac{AC}{OC}$

or $= \frac{\sqrt{OA^2 - OC^2}}{OC} = \frac{\sqrt{r^2 - y^2}}{y}$

or $\mu^2 = \frac{r^2 - y^2}{y^2}$

$$\mu^2 y^2 + y^2 = r^2$$

$$y = \frac{r}{\sqrt{\mu^2 + 1}}$$

$$h = BC = OB - OC = r - y$$

$$= r - \frac{r}{\sqrt{\mu^2 + 1}} = r\left[1 - \frac{1}{\sqrt{\mu^2 + 1}}\right]$$

287 **(c)**

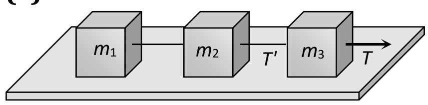
Initially particle was at rest. By the application of force its momentum increases

Final momentum of the particle = Area of F-t graph

$\Rightarrow mu$ = Area of semi circle

$$mu = \frac{\pi r^2}{2} = \frac{\pi r_1 r_2}{2} = \frac{\pi(F_0)(T/2)}{2} \Rightarrow u = \frac{\pi F_0 T}{4m}$$

288 **(c)**

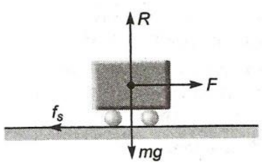


$$T' = (m_1 + m_2) \times \frac{T}{m_1 + m_2 + m_3}$$

289 **(c)**

Here, , $m = 2$ kg, $\mu_s = 0.54, F = 2.8$ N, $g = 10\text{ ms}^{-2}$

Limiting force of friction,



$$f_s = \mu_s R = \mu_s mg = 0.54 \times 2 \times 10 = 10.8 \text{ N}$$

As $F < f_s$, therefore, the block dose not move. As static friction is itself an adjusting friction. Hence, frictional force between the block and the floor will be 2.8 N

290 **(d)**

For block to continue motion on belt, acceleration $a = +\mu g = 0.2 \times 10 = 2\text{ ms}^{-2}$

$\therefore$ Velocity of belt = Velocity of block after 4 s = 2 × 4

$= 8\ \text{ms}^{-1}$

291 **(a)**

Coefficient of friction $\mu_s = \frac{F_1}{R} = \frac{75}{mg} = \frac{75}{20\times 9.8} = 0.38$

292 **(d)**

Since action and reaction acts in opposite direction on same line, hence angle between them is 180°

293 **(b)**

We know $s = \frac{u^2}{2\mu g}$ $\therefore$ $\mu = \frac{u^2}{2gs} = \frac{(6)^2}{2\times 10\times 9} = 0.2$

295 **(d)**

Coefficient of friction $\mu = \tan\theta\left[1 - \frac{1}{2^2}\right]$

Here, , $\theta = 45°$ and $n = 2$

$\therefore$ $\mu = \tan 45°\left[1 - \frac{1}{2^2}\right]$

$= 1 - \frac{1}{4}$

$= \frac{3}{4} = 0.75$

296 **(b)**

Kinetic energy required by body

$=$ (Total work done on the body)

$-$ (work against friction)

$= F \times S - \mu mgS = 25 \times 10 - 0.2 \times 5 \times 10 \times 10$

$= 250 - 100 = 150\ Joule$

297 **(c)**

Impulse , $I = F \times \Delta t = 50 \times 10^{-5} \times 3 = 1.5 \times 10^{-3} N - s$

298 **(b)**

$$a = \frac{m_2}{m_1 + m_2} g = \frac{3}{7+3} 10 = 3\ m/s^2$$

299 **(b)**

$a = \mu g = 5$

$v^2 = u^2 + 2as$

$0 = 2^2 + 2 \times (5)s$

$s = -\frac{2}{5}$ w.r.t. belt

Or distance $= 0.4\ m$

300 **(a)**

Acceleration of combined system,

$a = \frac{m_1 - m_2}{m_1 + m_2} . \text{g}$

$= \frac{3-2}{3+2} \times 9.8 = 1.96\ \text{ms}^{-2}$

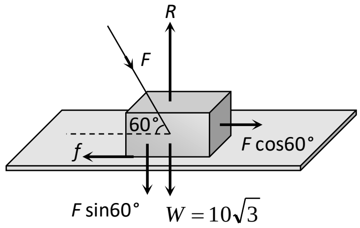
Vertically upward velocity of 2 kg mass at the time breaking of string,

$v = at = 5 \times 1.96 = 9.8\ \text{ms}^{-2}$

After breaking of string, mass m_2 moves under gravity and go further higher through a height h, where final velocity is zero. Hence

$(0)^2 - (9.8)^2 = 2 \times (-9.8) \times h$ or $h = 4.9$ m

301 **(a)**



$f = \mu R \Rightarrow F\cos 60° = \mu(W + F\sin 60°)$

Substituting $\mu = \frac{1}{2\sqrt{3}}$ &$W = 10\sqrt{3}$

We get $F = 20\ N$

302 **(b)**

$\vec{F} = m\vec{a}$

303 **(c)**

Impulse $=$ $\Delta P = m(V_f - V_i) = 0.4[1 - (-1)] = 0.8\ Ns$

304 **(c)**

The reading of balance A will decrease due to the upward thrust caused b buoyancy. The upthrust will be equal to the weight of water displaced. The net downward force due to mass immersed in water will add to effective weight of the system. So, the reading of balance B will increase

305 **(c)**

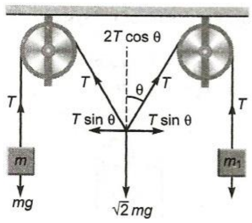
$$F = \frac{dp}{dt} = v\left(\frac{dM}{dt}\right) = \alpha v^2\ \ \therefore a = \frac{F}{M} = \frac{\alpha v^2}{M}$$

306 **(c)**

From force diagram shown in figure,

$T = mg$..(i)

and $2T\cos\theta = \sqrt{2}\,mg$ ... (ii)



Combing Eqs. (i) and (ii), we have

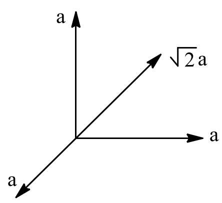
$2mg\cos\theta = \sqrt{2}mg$

or $\cos\theta = \frac{1}{\sqrt{2}}$

or $\theta = 45°$

307 **(a)**

Resultant acceleration $(a)_R = \sqrt{2}a - a$



$(a)_R = (\sqrt{2} - 1)a$

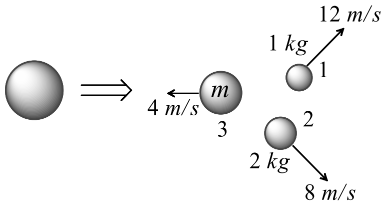
309 **(a)**

For jumping the presses the spring platform, so the reading of spring balance increases first and finally it becomes zero

310 **(b)**

$F = \sqrt{(F)^2 + (F)^2 + 2F.F\cos\theta} \Rightarrow \theta = 120°$

311 **(a)**



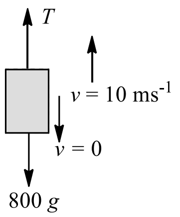
According to conservation of linear momentum

$p_3 = \sqrt{p_1^2 + p_2^2}$

$\Rightarrow m \times 4 = \sqrt{(1\times 12)^2 + (2\times 8)^2} = 20 \Rightarrow m = 5\,kg$

312 **(c)**

As the elevator is going down with decreasing speed, so acceleration is upward duration, Let it is a



$T - 800\text{g} = 800a,$

$T = 800(\text{g} + a)$

From $v^2 = u^2 - 2as,$

$\therefore\ a = 2\text{ms}^{-2}$

$\therefore\ T = 800(10+2),$

$\therefore\ T = 9600$ N

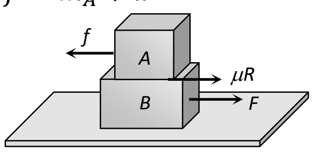
313 **(a)**

There is no friction between the body B and surface of the table. If the body B is pulled with force F then

$F = (m_A + m_B)a$

Due to this force upper body A will feel the pseudo force in a backward direction

$f = m_A + a$



But due to friction A and B, body will not move. The body A will start moving when pseudo force is more than friction force

$i.e.$ for slipping, $m_A a = \mu m_A g$

$\therefore a = \mu g$

314 **(a)**

The situation is shown in figure.

At an angle of 60°.

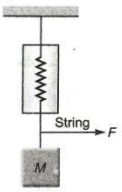
$T\cos\theta = mg$

$T = \dfrac{mg}{\cos\theta}$

$= \dfrac{10g}{\cos 60°}$

$= \dfrac{10}{1/2}$ kg– wt

20 kg– wt



315 **(d)**

law of conservation of momentum gives

$m_1 v_1 = m_2 v_2$

$\Rightarrow \dfrac{m_1}{m_2} = \dfrac{v_2}{v_1}$

But, $m = \dfrac{4}{3}\pi r^3 \rho$

or $m \propto r^3$

$\therefore\ \dfrac{m_1}{m_2} = \dfrac{r_1^3}{r_2^3} = \dfrac{v_2}{v_1}$

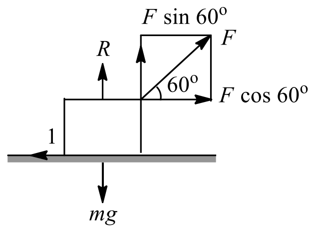
$\Rightarrow \dfrac{r_1}{r_2} = \left(\dfrac{1}{2}\right)^{1/3}$

$\therefore\ r_1 : r_2 = 1 : 2^{1/3}$

316 **(b)**

$R + F\sin 60° = mg$ or $R = mg - \frac{\sqrt{3}F}{2}$

$F\cos 60° = f = \mu R$



or $\frac{F}{2} = 0.5\left[1 \times 10 - \frac{\sqrt{3}F}{2}\right]$

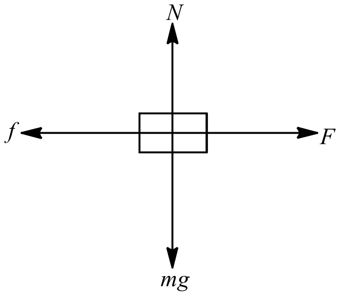
or $F + \frac{\sqrt{3}F}{2} = 10$ or $F = \frac{20}{2+\sqrt{3}}$

or $F = \frac{20}{3.732}$ N= 5.36 N

317 **(a)**

The various forces acting on the block are as shown

As the truck moves in forward direction with acceleration 2 m/s^2, the box experiences a force F



in backward direction,

$F = ma = 40 \times 2 = 80$ N

in backward direction.

Its motion will be opposed by force of friction

$f = \mu N = \mu mg = 0.15 \times 40 \times 10 = 60$N

The acceleration of the box relative to the truck toward the rear end is

$$a = \frac{F - f}{m} = \frac{80 - 60}{40} = 0.5\ m/s^2$$

If t be the time taken by the box to fall off the truck

$$s = ut + \frac{1}{2}at^2$$

$$5 = 0 + \frac{1}{2} \times 0.5 \times t^2$$

$$t = \sqrt{20}s$$

During this time distance covered by truck

$$x = 0 \times t + \frac{1}{2} \times 2 \times (\sqrt{20})^2 = 20\text{ m}$$

318 **(b)**

The pressure on the rear side would be more due to fictitious force (acting in the opposite direction of acceleration) on the rear face. Consequently the pressure in the front side would be lowered

319 **(d)**

Using law of conservation of momentum, we get

$100 \times v = 0.25 \times 100 \Rightarrow v = 0.25\ m/s$

320 **(c)**

Initial thrust must be

$m[g + a] = 3.5 \times 10^4(10 + 10) = 7 \times 10^5 N$

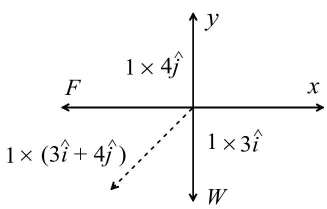
321 **(d)**

According to law of conservation of momentum the third piece has momentum

$= 1 \times -(3i + 4\hat{j})kgms^{-1}$

Impulse = Average force × time

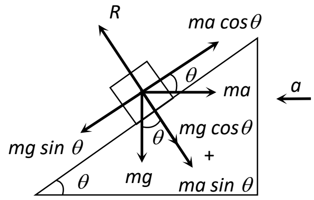
$$\Rightarrow \text{Average force} = \frac{\text{Impulse}}{\text{time}}$$



$$= \frac{\text{Change in momentum}}{\text{time}}$$

$$= \frac{-(3\hat{\imath} + 4\hat{\jmath})kgms^{-1}}{10^{-4}s} = -(3\hat{\imath} + 4\hat{\jmath}) \times 10^4 N$$

323 **(d)**



When the whole system is accelerated towards left then pseudo force (ma) works on a block towards right

For the condition of equilibrium

$$mg \sin\theta = ma \cos\theta \Rightarrow a = \frac{g \sin\theta}{\cos\theta}$$

∴ Force exerted by the wedge on the block

$$R = mg\cos\theta + ma\sin\theta$$

$$R = mg\cos\theta + m\left(\frac{g\sin\theta}{\cos\theta}\right)\sin\theta$$

$$= \frac{mg(\cos^2\theta + \sin^2\theta)}{\cos\theta}$$

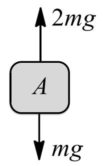
$$R = \frac{mg}{\cos\theta}$$

324 **(b)**

For A, $T = f = 2mg$

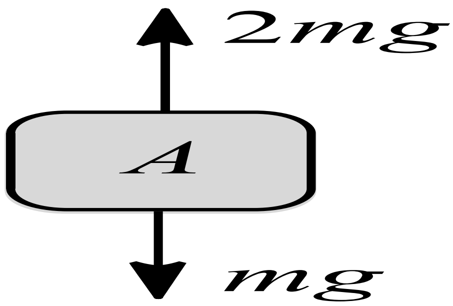
$2mg - mg = ma_1$

∴ $a_1 = \text{g}$



For B,

From force diagram shown in figure,



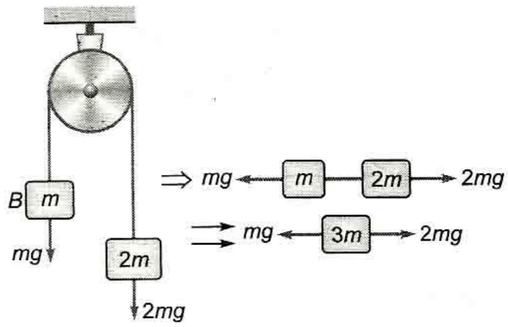
$2mg - mg = 3ma_2$

$$a_2 = \frac{\text{g}}{3}$$

For C,

∴ $2mg - mg = 2ma_3$

$$\therefore\ a_3 = \frac{\text{g}}{2}$$



So, $a_1 > a_3 > a_2$

325 **(c)**

$$T_1 = \left(\frac{m_2 + m_3}{m_1 + m_2 + m_3}\right) g = \frac{3+5}{2+3+5} \times 10 = 8\,N$$

327 **(a)**

Mass of the person $M = 80$ kg

Mass of the parachute $m = 5$ kg

$\therefore$ Total mass of the system $= M + m = 85$kg

Downward acceleration $a = 2.8$ ms^{-2}

Let upward force $= F$

Applying Newton's II law of motion to this system

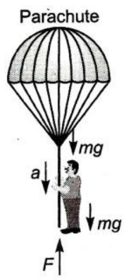
$F = (m + M)g - (m + M)a$

or $F = (m + M)(g - a)$

$F = 85(9.8 - 2.8)$N

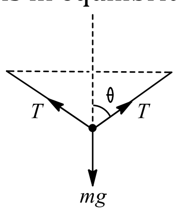
$= 85 \times 7$ N

$F = 595$ N



328 **(d)**

Let T be the tension in the string. Since the system is in equilibrium, therefore from figure



$2T \cos\theta = mg$

or $T = mg/2\ \cos\theta$

The string will be straight if $\theta = 90°$

$\therefore\ T = mg/2\ \cos 90° = mg/2(0) = \infty$

329 **(b)**

When a sudden jerk is given to C, an impulsive tension exceeding the breaking tension develops in C first, which breaks before this impulse can reach A as a wave through block

330 **(a)**

$$F = u\left(\frac{dm}{dt}\right) \Rightarrow \frac{dm}{dt} = \frac{F}{u} = \frac{210}{300} = 0.7\ kg/s$$

331 **(a)**

For body of mass 6 kg

$T = 6\text{g} = 6 \times 9.8 = 58.8$ N

For body of mass 4 kg

$T - T_1 = 4\text{g} = 4 \times 9.8 = 39.2$ N

$T_1 = T - 39.2$

$= 58.8 - 39.2 = 19.6$ N

332 **(a)**

$$\vec{F} = \frac{\Delta\vec{p}}{\Delta t} \Rightarrow \Delta t = \frac{|\Delta\vec{p}|}{|\vec{F}|} = \frac{0.4}{2} = 0.2\ s$$

333 **(d)**

$$v = u - at \Rightarrow u - \mu g t = 0\ \therefore\ \mu = \frac{u}{gt} = \frac{6}{10 \times 10}$$

$$= 0.06$$

334 **(d)**

Rate of flow of water $\frac{V}{t} = \frac{10\ cm^3}{\text{sec}} = 10 \times 10^{-6}\frac{m^3}{\text{sec}}$

Density of water $\rho = \frac{10^3 kg}{m^3}$

Cross-sectional area of pipe $A = \pi(0.5 \times 10^{-3})^2$

Force $= m\frac{dv}{dt} = \frac{mv}{t} = \frac{V\rho v}{t} = \frac{\rho V}{t} \times \frac{V}{At} =$

$\left(\frac{V}{t}\right)^2 \frac{\rho}{A}\left(\because v = \frac{V}{At}\right)$

By substituting the value in the above formula we get $F = 0.127\ N$

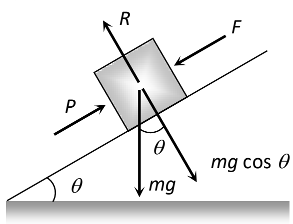
335 **(b)**

$u = 100\ m/s, v = 0, s = 0.06m$

Retardation $= a = \frac{u^2}{2s} = \frac{(100)^2}{2 \times 0.06} = \frac{1 \times 10^6}{12}$

$\therefore$ Force $= ma = \frac{5 \times 10^{-3} \times 1 \times 10^6}{12} = \frac{5000}{12} = 417\ N$

337 **(d)**



Net force along the plane

$= P - mg\sin\theta = 750 - 500 = 250\ N$

Limiting friction $= F_1 = \mu_s R = \mu_s mg\cos\theta$

$= 0.4 \times 102 \times 9.8 \times \cos 30 = 346\ N$

As net external force is less than limiting friction therefore friction on the body will be 250 N

338 **(c)**

At 11th second lift is moving upward with acceleration

$$a = \frac{0 - 3.6}{2} = -1.8\ m/s^2$$

Tension in rope, $T = m(g - a)$

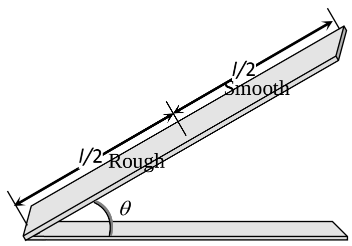
$= 1500(9.8 - 1.8) = 12000\ N$

339 **(d)**

For upper half

$v^2 = u^2 + 2al/2 = 2(g\sin\theta)l/2 = gl\sin\theta$

For lower half



$\Rightarrow 0 = u^2 + 2g(\sin\theta - \mu\cos\theta)\ \dfrac{l}{2}$

$\Rightarrow -gl\sin\theta = gl(\sin\theta - \mu\cos\theta)$

$\Rightarrow \mu\cos\theta = 2\sin\theta \Rightarrow \mu = 2\tan\theta$

340 **(a)**

Here, initial velocity of passenger train $u = v_1$; final velocity $v = v_2, a = -a$, distance $s = ?$

As $v^2 = u^2 + 2as$, so$v_2^2 = v_1^2 + 2(-a)s$

or $s = (v_1^2 - v_2^2)/2a$

341 **(d)**

Distance travelled by the lift

= Area under velocity time graph

$= \left(\dfrac{1}{2}\times 2\times 3.6\right) + (8\times 3.6) + \left(\dfrac{1}{2}\times 2\times 3.6\right)$

$= 36\ m$

342 **(a)**

Force equilibrium of system, $F_1 = \sqrt{F_2^2 + F_3^2}$ [As $\theta = 90°$]

In the absence of force F_1, Acceleration $= \frac{\text{Net Force}}{\text{Mass}}$

$= \dfrac{\sqrt{F_2^2 + F_3^2}}{m} = \dfrac{F_1}{m}$

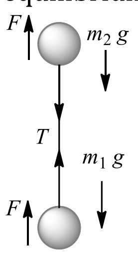
343 **(b)**

As weight $= 9.8\ N\ \therefore$ Mass $= 1\ kg$

Acceleration $= \frac{\text{Force}}{\text{Mass}} = \frac{5}{1} = 5\ m/s^2$

344 **(b)**

As both the balls are of same size, force of buoyancy on each is same. Therefore, in equilibrium,



$F + F = m_1\mathrm{g} + m_2\mathrm{g}$ or $F = (m_1 + m_2)\frac{\mathrm{g}}{2}$

Considering the equilibrium of lower ball,

$T + F = m_1\mathrm{g}$

$T = m_1\mathrm{g} - F$

$T = m_1\mathrm{g} - (m_1 + m_2)\dfrac{\mathrm{g}}{2}$

$T = (m_1 - m_2)\dfrac{\mathrm{g}}{2}$

345 **(b)**

Let a be the acceleration of each block. Then,

$T_3 = (m_1 + m_2 + m_3)a$ ....(i)

and $T_2 = (m_1 + m_2)a$ ....(ii)

from Eq. (i) and (ii), we get

$T_2 = \left(\dfrac{m_1 + m_2}{m_1 + m_2 + m_3}\right) \times T_3$

$= \left(\dfrac{10 + 6}{10 + 6 + 4}\right) \times 40 = 32\ \mathrm{N}$

346 **(b)**

For the given condition, Static friction = Applied force = Weight of body $= 2 \times 10 = 20\ N$

347 **(c)**

For the smooth portion BC,

$u = 0, s = l, a = \mathrm{g}\sin\phi$

$u = ?$

From $v^2 - u^2 = 2as$

$v^2 - 0 = 2\mathrm{g}\sin\phi \times l$

For the rough portion CO

$u = v = \sqrt{2\mathrm{g}\sin\phi \cdot l}$

$v = 0, a = \mathrm{g}(\sin\phi - \mu\cos\phi)$

$s = l$

From $v^2 - u^2 = 2as$

$0 - 2\mathrm{g}l\sin\phi = 2\mathrm{g}(\sin\phi - \mu\cos\phi)l$

$-\sin\phi = \sin\phi - \mu\cos\phi$

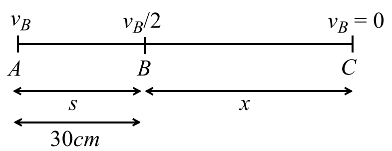
$\mu\cos\phi = 2\sin\phi$

$\mu = 2\tan\phi$

348 **(b)**

$F = u\left(\dfrac{dm}{dt}\right) = 400 \times 0.05 = 20\ N$

349 **(c)**



Let bullet is fired with velocity v_B at point A and its velocity becomes half when it travels a distance s and reaches at point B. When it reaches at point C, it comes to rest and travels a distance x

From A to B, using, $v^2 - u^2 = 2as$

$\Rightarrow \left(\dfrac{v_B}{2}\right)^2 - v_B^2 = 2as \Rightarrow \dfrac{v_B^2}{4} - v_B^2 = 2as$

$\Rightarrow \dfrac{-3v_B^2}{4} = 2as \Rightarrow a = \dfrac{-3v_B^2}{8s}$

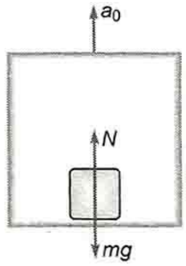
$\therefore$ From$B$to$C$,using$v^2 - u^2 = 2as$

$$0^2 - \left(\frac{v_B}{2}\right)^2 = 2as \Rightarrow \frac{-v_B^2}{4} = 2\left(\frac{-3v_B^2}{8s}\right)x$$

$$\Rightarrow x = \frac{8s}{4 \times 6} = \frac{8 \times 30}{24} = 10\ cm$$

350 **(a)**

From force diagram shown in figure,



$N - mg = ma_0$

or $120 - mg = 2m$

$\therefore m = \frac{100}{10 + 2}$

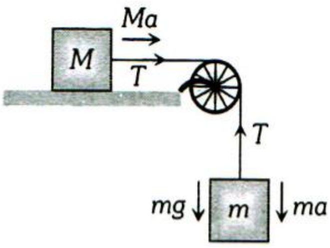
$= 10$ kg

351 **(a)**

When the string C is stretched slowly, the tension in A is greater than that of C, because of the weight mg and the former reaches breaking point earlier

352 **(d)**

Force equation for 'M'



$Ma = T$...(i)

Force equation for, m

$mg - T = ma$ ...(ii)

On solving (i) and (ii)

$$T = \left(\frac{Mm}{M + m}\right)g$$

354 **(d)**

Force $= m\left(\frac{dv}{dt}\right) = \frac{0.25 \times [(10) - (-10)]}{0.01} = 25 \times 20 = 500\ N$

355 **(c)**

$F = 600 - 2 \times 10^5 t = 0 \Rightarrow t = 3 \times 10^{-3}$sec

Impulse $I = \int_0^t F dt = \int_0^{3 \times 10^{-3}} (600 - 2 \times 10^5 t) dt$

$= [600t - 10^5 t^2]_0^{3 \times 10^{-3}} = 0.9\ N \times$ sec

356 **(b)**

Change of momentum of one bullet is mv

Time for 1 bullet $= \frac{1}{n}$

$\therefore$ Force = time rate of change of momentum

$= \frac{mv}{1/n} = mnv$

357 **(a)**

Since acceleration of lift is zero

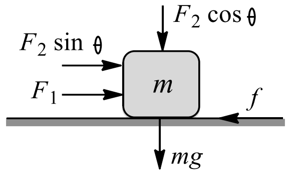
358 **(a)**

The mass m is not moving with respect to the lift and also has no tendency to move. Hence, friction force acting on it is equal to zero

359 **(a)**

$R = mg + F_2 \cos\theta, f = \mu R$

$f = \mu(mg + F_2 \cos\theta)$



Also, $f = F_1 + F_2 \sin\theta$

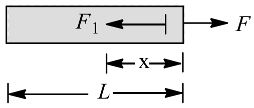
Equating, $\mu(mg + F_2 \cos\theta)$

$= F_1 + F_2 \sin\theta$

or $\mu = \frac{F_1 + F_2 \sin\theta}{mg + F_2 \cos\theta}$

360 **(a)**

$F - F_1 = (dm)a$



Acceleration of rope $a = \frac{F}{m}$

$dm = \frac{m}{L}x$

$F - F_1 = \frac{mx}{L} \times \frac{F}{m}$

$F - F_1 = \frac{Fx}{L}$ or $F_1 = \frac{F(L-x)}{L}$

361 **(c)**

Mass measured by physical balance remains unaffected due to variation in acceleration due to gravity

362 **(a)**

The net electromagnetic force $= \sqrt{N^2 + f^2}$

But $N = mg, f = \mu mg$

Force $= mg\sqrt{1 + \mu^2}$

363 **(a)**

Net frictional force between block and surface is

$F = \mu R = 0.5 \times 10 \times 10 = 5$ N

Applied force is 10 N and it is less than 50 N.

$\therefore$ System is at rest and no friction between A and B.

364 **(b)**

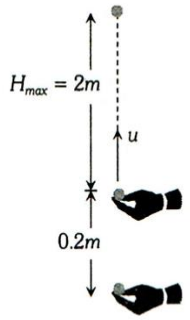
$s = \frac{u^2}{2\mu g} = \frac{(20)^2}{2 \times 0.5 \times 10} = 40\ m,$

$72\ km/hr = 72 \times \frac{5}{18} = 20\ m/s$

365 **(c)**

Let the ball starts moving with velocity 'u' and it

reaches upto maximum height H_{max}, then



From $H_{max} = \frac{u^2}{2g}$

$u = \sqrt{2g\ (H_{max})}$

$= \sqrt{2 \times 10 \times 2} = 2\sqrt{10} m/s$

This velocity is supplied to the ball by the hand and initially the hand was at rest,

it acquires this velocity in distance of 0.2 *meter*

$\therefore a = \frac{u^2}{2s} = \frac{40}{2 \times 0.2} = 100\ m/s^2$

So upward force on the ball $F = m(g + a)$

$= 0.2(10 + 100) = 0.2 \times 110 = 22N$

366 **(b)**

For body $A, T = M_1 a = 7a$

For body $B, M_2 g - T = 3a$

$3g - 7a = 3a$

$10a = 3g$

$a = \frac{3g}{10} = \frac{3 \times 10}{10} = 3\ \text{ms}^{-2}$

367 **(c)**

For $W, 2W, 3W$ apparent weight will be zero because the system is falling freely. So the distances of the weight from the rod will be same

368 **(a)**

Force exerted by ball on wall

= rate of change in momentum of ball

$= \frac{mv - (-mv)}{t} = \frac{2mv}{t}$

369 **(c)**

Various forces acting on the ball are as shown in figure. The three concurrent forces are in equilibrium. Using Lami's theorem

$\frac{T_1}{\sin 150°} = \frac{T_2}{\sin 120°}$

$= \frac{10}{\sin 90°}$

$\frac{T_1}{\sin 30°} = \frac{T_2}{\sin 60°} = \frac{10}{1}$

$\therefore T_1 = 10 \sin 30°$

$= 10 \times 0.5 = 5\text{N}$

$T_2 = 10 \sin 60°$

and $= 10 \times \frac{\sqrt{3}}{2} = 5\sqrt{3}\text{N}$

370 **(d)**

$t = \frac{v}{a} \Rightarrow t \propto \frac{1}{a} (v \text{ is same})$

$\Rightarrow \frac{t_1}{t_2} = \frac{a_2}{a_1} = \frac{m_1}{m_2} = \frac{3}{5} \left[\because a \propto \frac{1}{m}, F \text{is same}\right]$

371 **(b)**

$P = f_{ms} = \mu_s mg$

When the body starts moving with acceleration a, then

$P - f_k = ma$

$\mu_s mg - \mu_k mg = ma$ or $a = (\mu_0 - \mu_k)g$

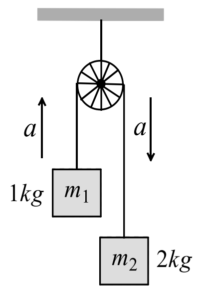
or $a = (0.5 - 0.4)10$

$= 0.1 \times 10\text{ms}^{-2} = 1\text{ms}^{-2}$

372 **(b)**

Due to Newton's third law

373 **(a)**



Here, $m_1 = 1kg, m_2 = 2kg$

The acceleration of the system is

$a = \frac{(m_2 - m_1)g}{m_1 + m_2} = \frac{(2-1)g}{1+2} = \frac{g}{3} = \frac{10}{3}$

Acceleration of the centre of mass is

$a_{cm} = \frac{m_1 a_1 + m_2 a_2}{m_1 + m_2} = \frac{1(-a) + 2(a)}{1+2}$

$= \frac{1\left(\frac{-g}{3}\right) + 2\left(\frac{g}{3}\right)}{3}$

$= \frac{g}{9} = \frac{10}{9}$

The distance travelled by the centre of mass in two seconds is

$S = \frac{1}{2} a_{cm} t^2 = \frac{1}{2} \times \frac{10}{9} \times (2)^2 = \frac{20}{9} m$

1)	c	2)	b	3)	c	4)	c	189)	b	190)	a	191)	d	192)	c
5)	a	6)	b	7)	d	8)	c	193)	a	194)	c	195)	b	196)	a
9)	b	10)	b	11)	a	12)	a	197)	b	198)	d	199)	c	200)	c
13)	d	14)	c	15)	b	16)	b	201)	d	202)	c	203)	a	204)	b
17)	c	18)	c	19)	c	20)	a	205)	a	206)	c	207)	d	208)	d
21)	d	22)	b	23)	b	24)	a	209)	b	210)	a	211)	b	212)	c
25)	b	26)	b	27)	d	28)	a	213)	a	214)	c	215)	c	216)	d
29)	d	30)	d	31)	b	32)	c	217)	a	218)	d	219)	d	220)	a
33)	b	34)	d	35)	b	36)	a	221)	a	222)	c	223)	a	224)	c
37)	c	38)	c	39)	d	40)	a	225)	b	226)	c	227)	b	228)	c
41)	b	42)	a	43)	a	44)	c	229)	a	230)	c	231)	a	232)	a
45)	b	46)	d	47)	b	48)	a	233)	d	234)	b	235)	a	236)	d
49)	c	50)	a	51)	d	52)	b	237)	b	238)	c	239)	b	240)	d
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57)	b	58)	c	59)	c	60)	d	245)	c	246)	d	247)	a	248)	b
61)	a	62)	c	63)	b	64)	c	249)	a	250)	b	251)	c	252)	c
65)	a	66)	a	67)	a	68)	b	253)	a	254)	c	255)	d	256)	d
69)	a	70)	c	71)	d	72)	a	257)	b	258)	d	259)	b	260)	a
73)	b	74)	b	75)	b	76)	d	261)	b	262)	b	263)	d	264)	d
77)	d	78)	c	79)	d	80)	d	265)	d	266)	c	267)	c	268)	d
81)	c	82)	d	83)	d	84)	a	269)	b	270)	c	271)	b	272)	c
85)	a	86)	b	87)	d	88)	c	273)	d	274)	c	275)	a	276)	a
89)	d	90)	a	91)	b	92)	b	277)	a	278)	d	279)	c	280)	c
93)	a	94)	d	95)	d	96)	c	281)	a	282)	c	283)	c	284)	d
97)	a	98)	d	99)	b	100)	b	285)	d	286)	a	287)	c	288)	c
101)	c	102)	b	103)	d	104)	b	289)	c	290)	d	291)	a	292)	d
105)	b	106)	c	107)	a	108)	c	293)	b	294)	c	295)	d	296)	b
109)	b	110)	c	111)	b	112)	c	297)	c	298)	b	299)	b	300)	a
113)	b	114)	d	115)	c	116)	a	301)	a	302)	b	303)	c	304)	c
117)	b	118)	a	119)	d	120)	d	305)	c	306)	c	307)	a	308)	c
121)	d	122)	d	123)	a	124)	d	309)	a	310)	b	311)	a	312)	c
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141)	c	142)	b	143)	b	144)	b	329)	b	330)	a	331)	a	332)	a
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165)	d	166)	a	167)	c	168)	a	353)	d	354)	d	355)	c	356)	b
169)	c	170)	d	171)	b	172)	a	357)	a	358)	a	359)	a	360)	a
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177)	b	178)	d	179)	c	180)	a	365)	c	366)	b	367)	c	368)	a
181)	a	182)	d	183)	a	184)	a	369)	c	370)	d	371)	b	372)	b
185)	d	186)	a	187)	d	188)	a	373)	a						

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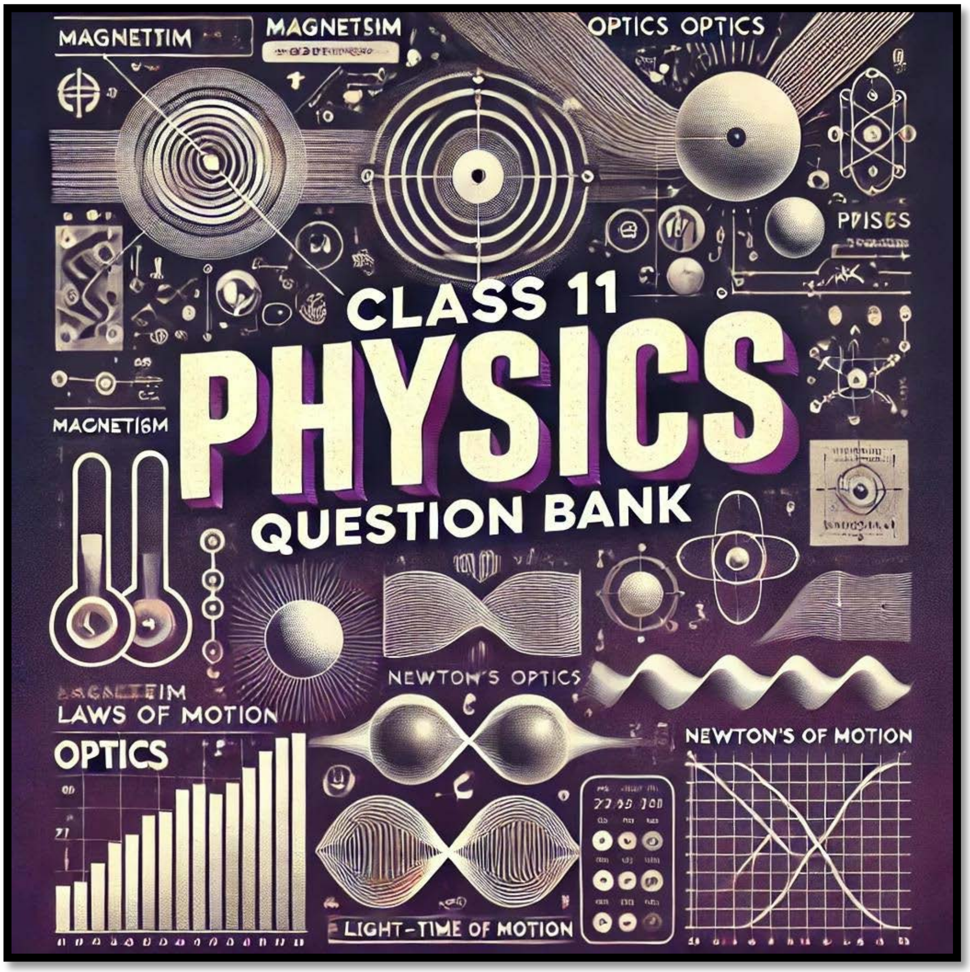

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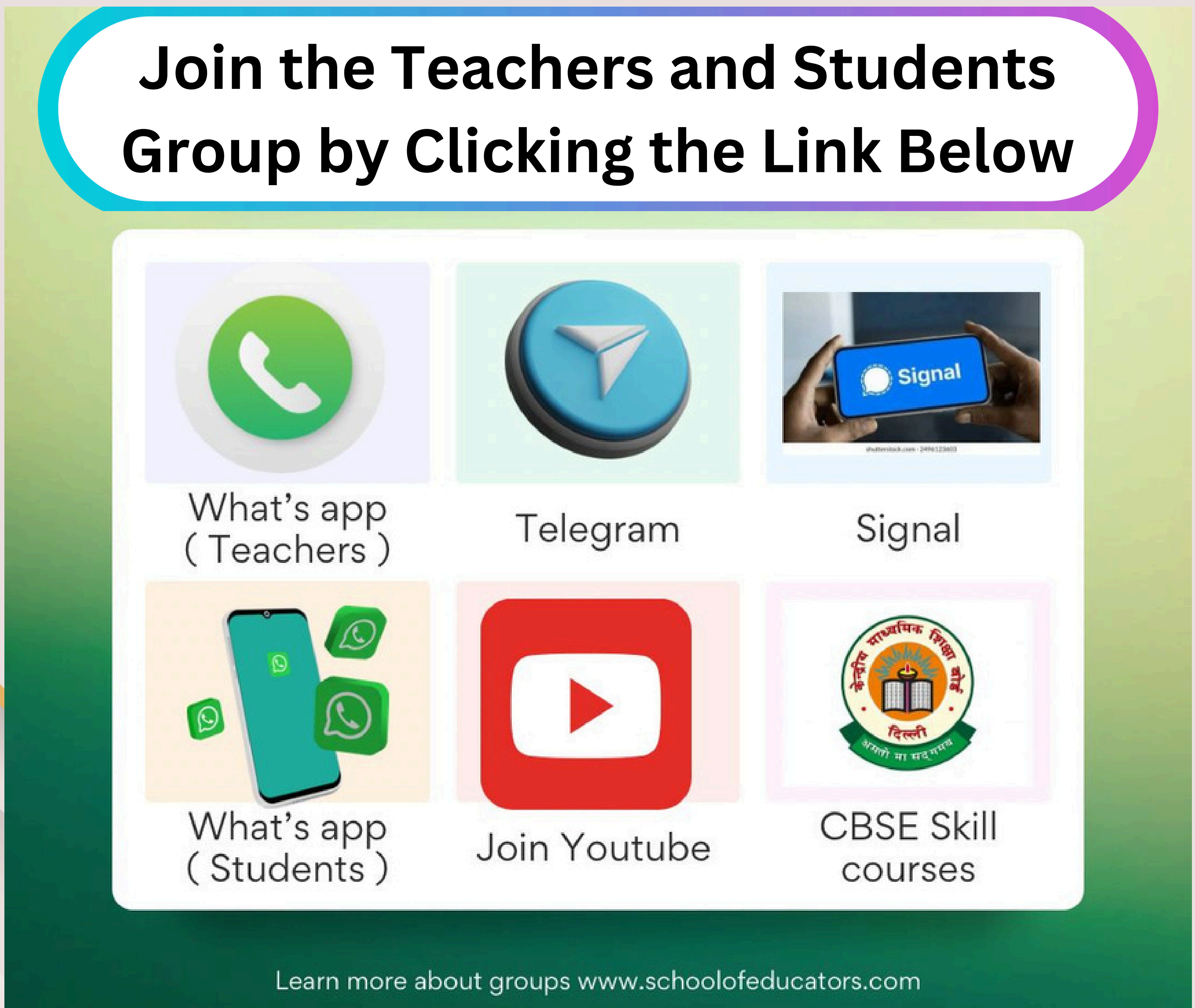

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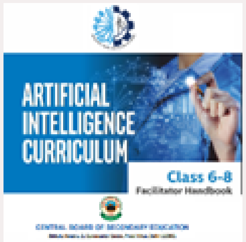

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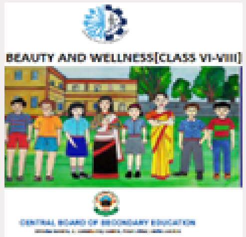
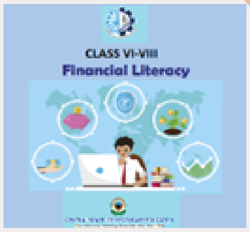


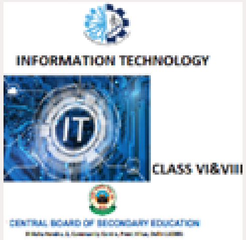
Beauty & Wellness

Design Thinking & Innovation



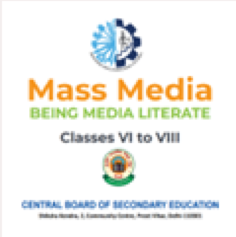
Financial Literacy

Handicrafts

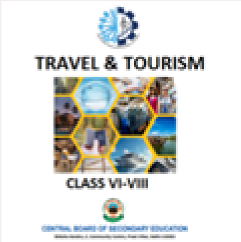


Information Technology

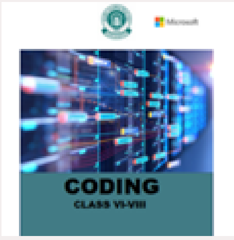
Marketing/Commercial Application



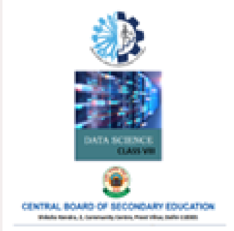
Mass Media - Being Media Literate



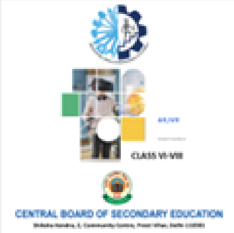
Travel & Tourism



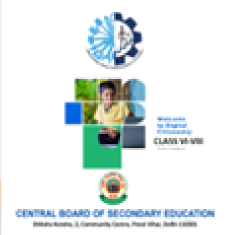
Coding



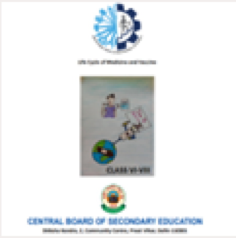
Data Science (Class VIII only)



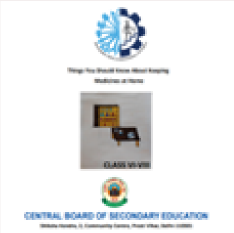
Augmented Reality / Virtual Reality



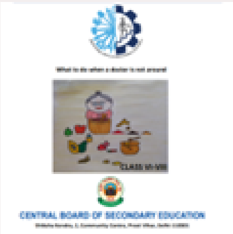
Digital Citizenship



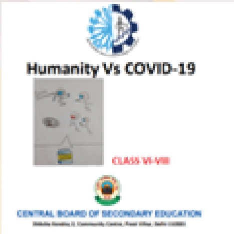
Life Cycle of Medicine & Vaccine



Things you should know about keeping Medicines at home

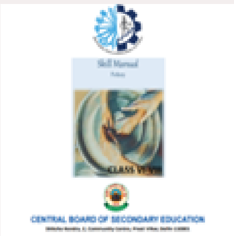


What to do when Doctor is not around

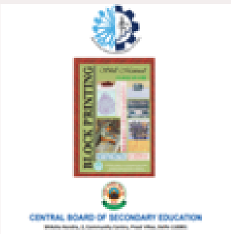


Humanity & Covid-19

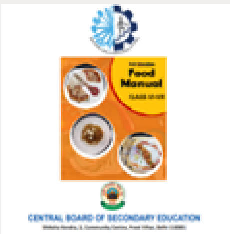
Blue Pottery

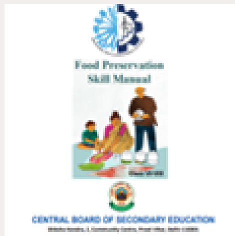


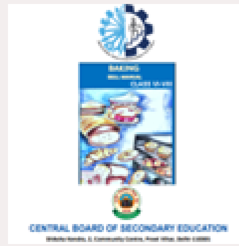
Pottery

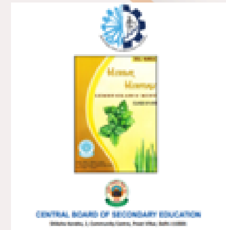


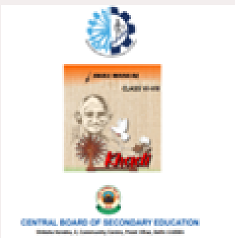
Block Printing

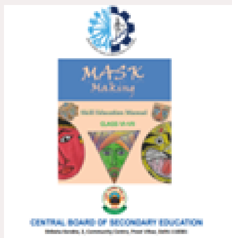

Food

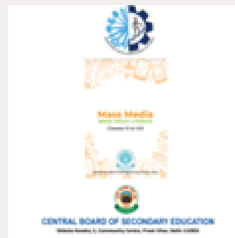

Food Preservation

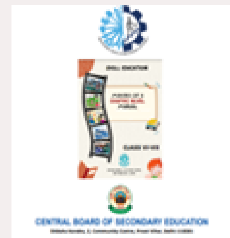

Baking

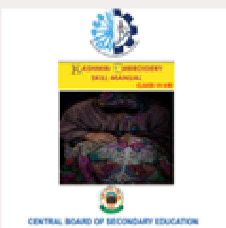

Herbal Heritage


Khadi


Mask Making

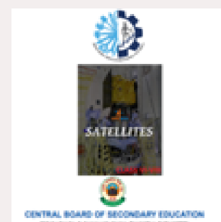

Mass Media

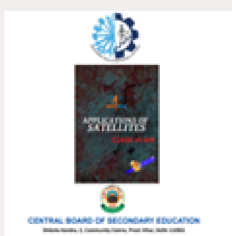

Making of a Graphic Novel


Kashmiri Embroidery


Embroidery

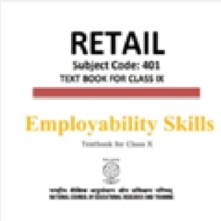

Rockets


Satellites

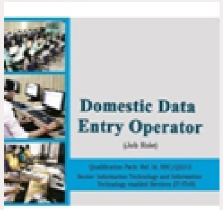

Application of Satellites

Photography

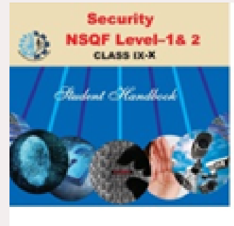
SKILL SUBJECTS AT SECONDARY LEVEL (CLASSES IX – X)



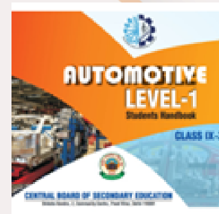
Retail



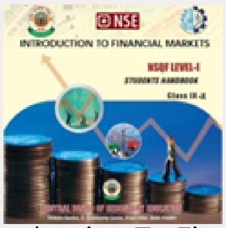
Information Technology



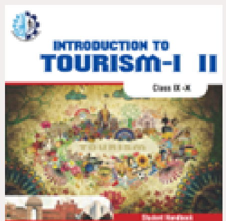
Security



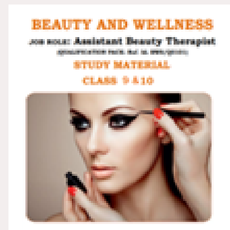
Automotive



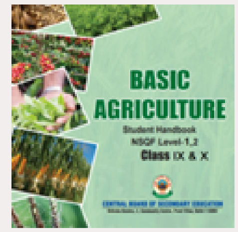
Introduction To Financial Markets



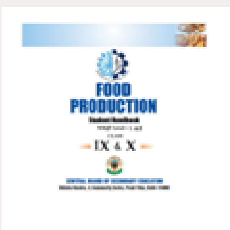
Introduction To Tourism



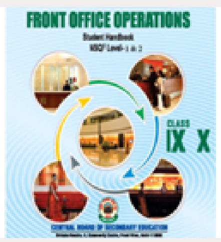
Beauty & Wellness



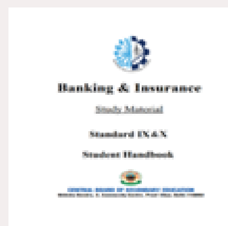
Agriculture



Food Production

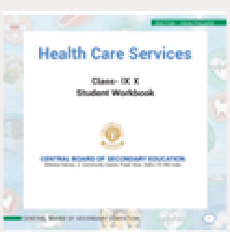


Front Office Operations



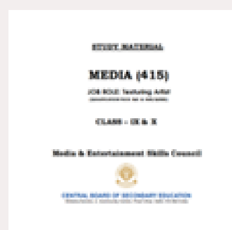
Banking & Insurance

Marketing & Sales

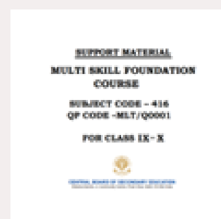


Health Care

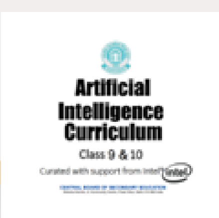
Apparel



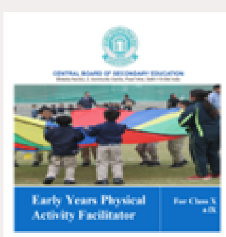
Multi Media



Multi Skill Foundation Course



Artificial Intelligence

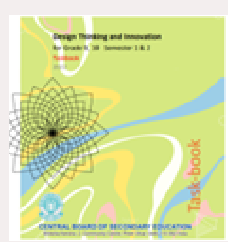


Physical Activity Trainer

Data Science

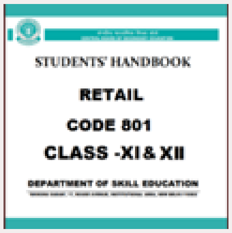
Electronics & Hardware (NEW)

Foundation Skills For Sciences (Pharmaceutical & Biotechnology)(NEW)



Design Thinking & Innovation (NEW)

SKILL SUBJECTS AT SR. SEC. LEVEL (CLASSES XI – XII)



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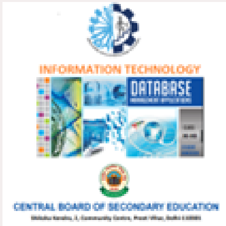
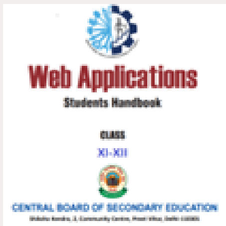
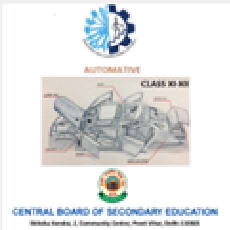


InformationTechnology

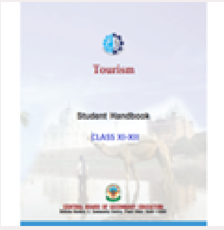


Web Application

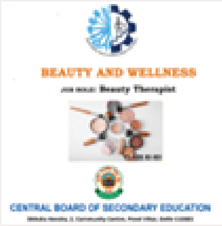


Automotive

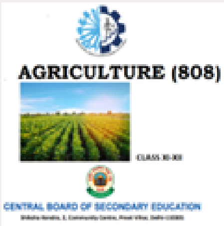
Financial Markets Management



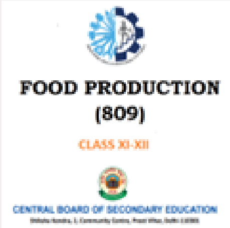
Tourism



Beauty & Wellness

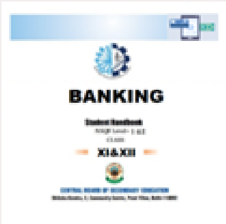


Agriculture

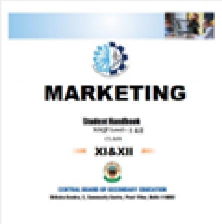


Food Production

Front Office Operations



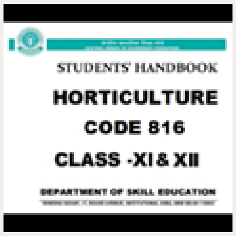
Banking



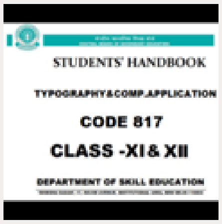
Marketing

Health Care

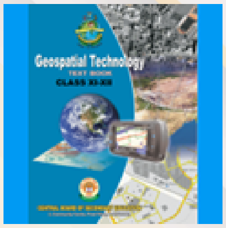
Insurance



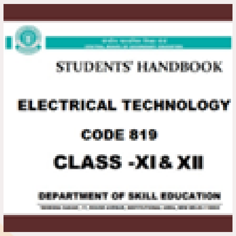
Horticulture



Typography & Comp. Application

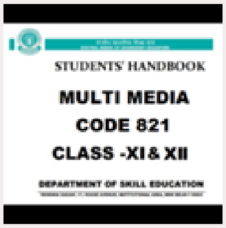


Geospatial Technology

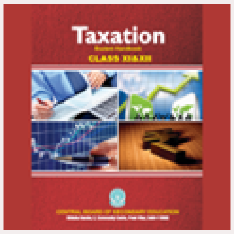


Electrical Technology

Electronic Technology

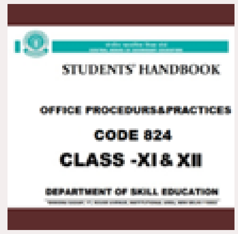


Multi-Media

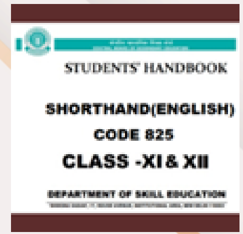


Taxation

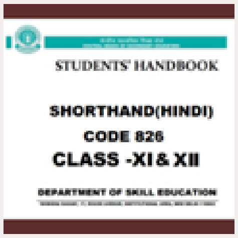
Cost Accounting



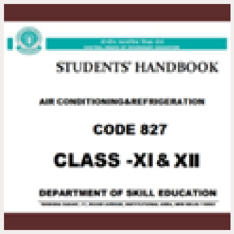
Office Procedures & Practices



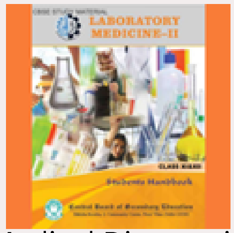
Shorthand (English)



Shorthand (Hindi)

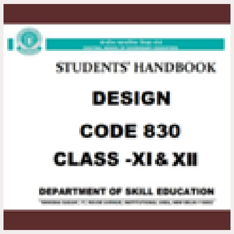


Air-Conditioning & Refrigeration

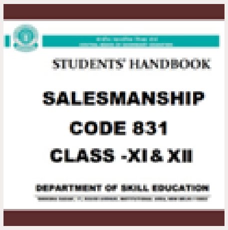


Medical Diagnostics

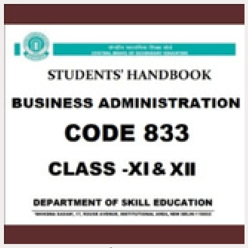
Textile Design



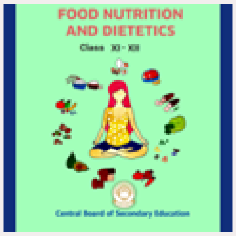
Design



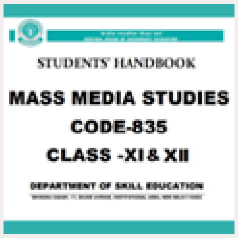
Salesmanship



Business Administration

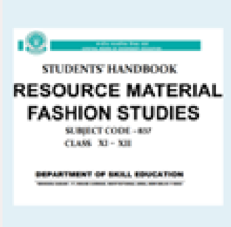


Food Nutrition & Dietetics

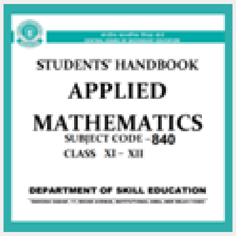


Mass Media Studies

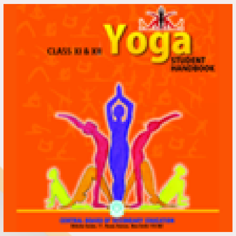
Library & Information Science



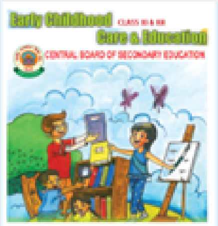
Fashion Studies



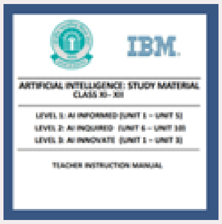
Applied Mathematics



Yoga

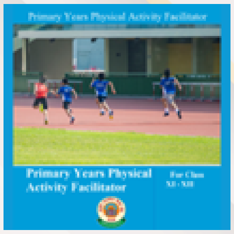


Early Childhood Care & Education

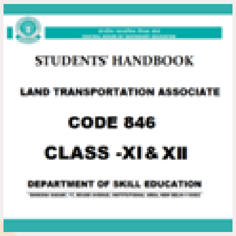


Artificial Intelligence

Data Science



Physical Activity Trainer(new)



Land Transportation Associate (NEW)

Electronics & Hardware (NEW)

Design Thinking & Innovation (NEW)

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Class 11 (Com)

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Class 11 (Hum)

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